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THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

TABLE OF CONTENTS.

PAGE.

ASTRONOMY.

1. The Transit of Venus in New Zealand.* Prof. H. S. Pritchett. . . . 588
2. Astronomical Notes.* Prof. W. W. Alexander 591
3. Sun and Planets for February, 1884.* Wm. Dawson. 596

GEOLOGY.

1. The Fossil Fields of Southern Oregon.* Chas. H. Sternberg 596
2. Flint Chips.* Prof. G. C. Broadhead. 599
3. A New Mineral to Central Kansas.* Warren Kraus. 602

CHEMISTRY.

1. Kaw Water at Lawrence, Kansas.* Prof E. H. S. Bailey 603
2. Wonders of Photography 605
3. Progress in Artificial Lighting . . 610

ARCHÆOLOGY.

1. Recent Archæological Discoveries in New Mexico.* J. C. Cooper . . . 614
2. Mastodon Remains in Missouri.* A. M. Stalnaker 615

PROCEEDINGS OF SOCIETIES.

1. Memory.* Dr. R. Wood Brown. . . 616

METEOROLOGY.

1. The Weather Sphynx.* C. A. Shaw. 621
2. Kansas Weather Service.* Prof. J. T. Lovewell 627
3. A New Theory of Dew 628

PAGE.

ENGINEERING AND MINING.

1. Street Pavements.* W. B. Knight, C. E 630
2. The Street Paving Question. 631
3. Sewerage System of Memphis . . . 633
4. The Arlberg Tunnel 635
5. Mining in Colorado in 1883. 636
6. Recently Patented Improvement.* J. C. Higdon 637

BOOK NOTICES.*

1. Lectures on Painting. G. P. Putnam's Sons 639
2. The Organs of Speech. D. Appleton & Co 640
3. Where Did Life Begin? Chas Scribner's Sons 641
4. Electricity and Electrical Engineering. D Van Nostrand. 641
5. Third Annual Report U. S. Geological Survey 642
6. Political Recollections. Jansen, McClurg & Co 643
7. Knight's New Mechanical Dictionary. Houghton, Mifflin & Co . . . 644
8. Ballads of Home, Beauty and Bravery. Lee & Shepard 644
9. Other Publications Received 545

SCIENTIFIC MISCELLANY.

1. The Old Man of Hoy.* Rev. S. J. Douglass 645

EDITORIAL NOTES 647

ITEMS FROM PERIODICALS 649

* Written for the REVIEW.

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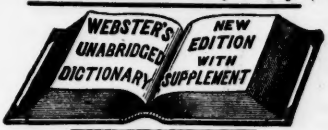

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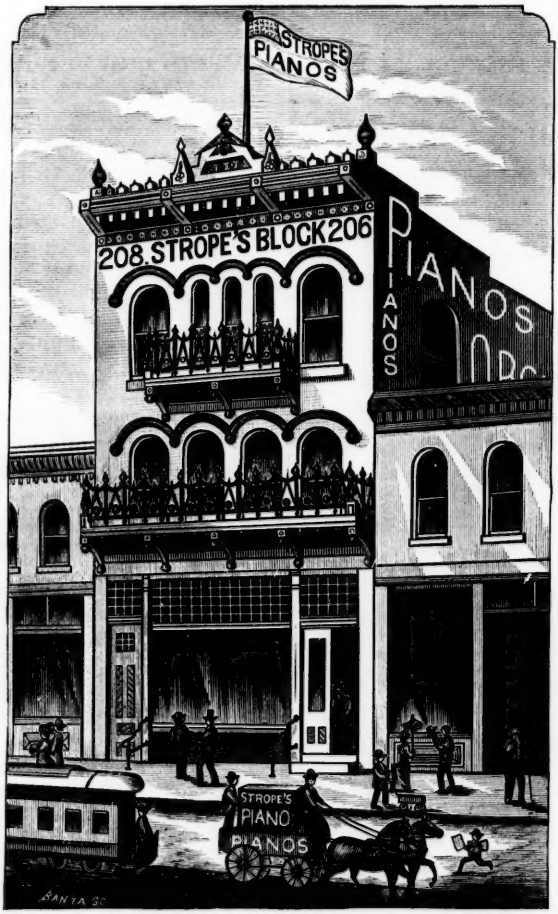

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VOL. VII. FEBRUARY, 1884. NO. 10.

ASTRONOMY.

THE TRANSIT OF VENUS IN NEW ZEALAND.

PROF. H. S. PRITCHETT.

A year has elapsed since the last transit of Venus, and as yet no definite announcement has been made of the results of the work of the different parties sent out by our Government. This delay is unavoidable in the discussion of such a large amount of data as was contained in the observations of the transit of 1882. At the time of observation it was generally understood that individual observers would make no independent publications of their observations. At this time, however, it will not be out of place to speak in general terms of the work of the parties and the probable results.

The United States sent into the field eight parties, four to the northern and four to the southern hemisphere. These parties were equipped in a very different manner from those of any other nation. The American parties not only observed contacts but they were provided with the apparatus and chemicals for obtaining pictures by the use of the horizontal photoheliograph.

Photography was first employed in observations of the transit of Venus in 1874. At that time the astronomers, both of Europe and America, were very hopeful of obtaining exceedingly accurate results from the photographic method. There was a radical difference of opinion, however, as to the form of instrument to be employed. The Europeans used a photoheliograph made after the Kew

pattern, having an objective of 3.4 inches aperture and 50 inches focus, and giving an image of the Sun of about half an inch in diameter which is enlarged by a secondary magnifier to about four inches in diameter. American astronomers contended that such instruments would be affected by troublesome errors due to the secondary magnifier and that position angles could not be obtained from it with sufficient accuracy. The Americans adopted the horizontal photoheliograph which is essentially a huge camera of long focus mounted accurately in the meridian and horizontal. The objective is a five-inch aperture and about forty feet focal length, giving images of the Sun upon the sensitive plate, of about four inches in diameter. A plain glass mirror guided by clock-work is used to throw the Sun's image upon the sensitive plate. The sensitive plate is mounted upon a solid pier enclosed in the photographic house.

The result of the discussion of the photographs of 1874 was a complete vindication of the American methods. The European photographs turned out to be valueless, while those obtained by the American parties yielded excellent results. It is much to be regretted that the publication of the results of the American photographs was so long delayed. It was only when the preparations for the transit for 1882 were well advanced that these results were made known. In the meantime an international congress of astronomers was held at Paris to consider how the transit of 1882 should be observed. The United States was not represented at this conference, and guided by their own experience alone, the European astronomers decided that the photographic method was a failure and should not be tried again. It is almost certain that had the success of the American photographs been known their action would have been altogether different. Thus it happened that the astronomers of America and Europe differed widely as to the best method of utilizing one of the most important astronomical events of the century. The Europeans rejected photography and trusted to observations of contacts only; the Americans observed contacts because it involved but little additional cost and labor, but looked to photography for the most valuable results.

During the summer of 1882 Congress was in session till late in the summer, and the appropriations for the transit of Venus were not passed till some time in August. In consequence the preparations for the transit were somewhat hurried and there was little opportunity for the photographers to practice.

The parties which went to the southern hemisphere were stationed at the Cape of Good Hope, Santiago in Chili, Santa Cruz in Patagonia, and New Zealand. The New Zealand party was one of the first to leave Washington, having a long journey to perform. The party, consisting of two astronomers and photographers, sailed from San Francisco September 24, 1882, in one of the Pacific Mail S. S. Company's steamers. The voyage to New Zealand was a very smooth and pleasant one, occupying twenty-one days. On the way the ship touched at Honolulu and passed through the Navigator Group of Islands.

Auckland, the port of landing for the American-Australian steamers, is one of the most picturesque places in the world and is probably the most flourishing

city in the colony. It has a magnificent harbor and is the commercial metropolis of the northern island. A fine volcano stands on an island in the harbor, and another rises just back of the city. The latter, called Mt. Eden, has a magnificent crater, perfectly complete. It is in the form of a huge bowl. The island here is only about six miles wide, and there is a good harbor on the western side opposite Auckland. From the summit of Mt. Eden the winding bays and inlets of both harbors lie spread out before the eye, forming one of the most beautiful pictures in the world.

The city of Auckland has a population of about 40,000, and is a well built and well governed city. The streets are broad, well paved and lighted; fine parks have been laid out and the public buildings are of a most substantial character.

The Maoris, the aborigines of New Zealand, are to be seen about Auckland and adjacent territory better than anywhere else in the colony. At one time they were nearly all nominal Christians, but at the present time they have lost most of their religious observances and rapidly learned all the vices of Europeans. They are fast dying out, and another half century will probably see them reduced to a few scattered remnants.

Nothing could have been more hospitable than the welcome we received from the Government and people of New Zealand. Every facility of the Government was put at our service, and every citizen of Auckland was anxious to do anything in his power to help along the work of the expedition. For various reasons Auckland was selected as the point of observation. A good site was found in the "Domain," a public park in the outskirts of the city. Permission was at once given for its use and for the erection of suitable buildings. These consisted of three small wooden buildings, one for the transit instrument, one for a photographic house and a building for the equatorial. These buildings were commenced as soon as an accurate meridian line could be obtained and the grounds properly laid off. The completion of the buildings was, however, a very tedious matter. In New Zealand nobody is in a hurry. The carpenters who worked for us came about nine in the morning, took an hour at noon for lunch and stopped work at five in the afternoon, and always took a half holiday on Saturday. It was impossible to hurry them much, but the buildings were all finished, and all instruments were in adjustment two weeks before the transit.

From this time on the party took regular practice with the photoheligraph, till each man became thoroughly familiar with his duties and could go through them in routine order. Photographs of the sun were taken every day and the adjustments of the instruments tested by every possible means. During the latter part of November a magnificent sunspot appeared, of which many good photographs were obtained.

As the day of transit drew nearer a feverish anxiety began to be felt in regard to the weather. Only the last half of the transit was visible in New Zealand, and this gave only about two and one-half hours for effective work. If the early morning should be cloudy all would be lost. This anxiety seemed to

extend itself to the most insignificant citizen of Auckland. The New Zealanders seemed to feel that the honor of New Zealand was involved in the matter, and that if a clear day was not forthcoming the fair name of the colony would suffer. Large numbers of people visited the station to express their interest in our success and their firm confidence in Auckland weather. Among the visitors were some who asked some very curious questions. One of the most common ones was this, "Will the transit occur at night or in the daytime?" On the night preceding the day of transit half the population of Auckland sat up to look out for the weather, and the American Transit-of-Venus party did very little sleeping. Every instrument had been put in perfect adjustment, instrumental errors determined most accurately and everything was in perfect readiness. At 12 o'clock it was perfectly clear, with every indication of a fine morning.

At 4 o'clock in the mornting the party was at the station ready for work, and their feelings may be better imagined than described when it is stated that a heavy bank of clouds covered the entire eastern sky, and apparently all the labor and expense of the past few months were to be thrown away. By 5 o'clock necessary adjustments were made and each man was at his post ready for work. The look of silent despair on the countenances of the various members of the party was said by the citizens of Auckland to have been the most heartrending spectacle ever seen in New Zealand.

At half past five the clouds broke away and photographing was commenced. Seventy-five photographs were obtained when the clouds again closed down and stopped work. Some of these photographs were taken while slight clouds covered the Sun, and these are too thin for measurement, but the most of them present sharp, round images of the Sun and Venus, and can be measured with great accuracy. Unfortunately one of the astronomers of the party was sick and unable to take part in the work, so that the observations of third contact, which was the only one of value, which we could see, depended on my own observations alone. My observations of third contact were much more satisfactory than I had anticipated. The phenomenon was much sharper and much more capable of accurate observations than I had expected from experience in observing the transit of Mercury. Thin clouds covered the Sun at the time so that a shade-glass was not necessary, and Venus came up to the limb presenting a perfectly sharp black disc. The contact took place without any distortion or any appearance of the various phenomena included under the name of "black drop." I felt sure of the time to within one or two seconds. The images were exceedingly steady and sharp.

It is hardly possible to give any definite statement as to the results of the work of the entire eight parties. A large number of photographs were obtained and satisfactory observations of contacts at most of the stations. It is altogether probable that the photographs will give a good determination of the solar parallax. It is stated that the images of the Sun in many of the pictures obtained by

two of the southern parties are elliptical instead of being truly circular as they should be. It is very difficult to see how this could occur.

It is to be remembered that the transit of Venus is only one of the methods used in obtaining the parallax of the Sun, and no one expects the solar parallax to be determined finally by this method alone. This determination will not be final till the results obtained from trigonometric, gravitational and photometric methods agree, and this will require the work of many years to come.

WASHINGTON UNIVERSITY, January 5, 1884.

ASTRONOMICAL NOTES.

PROF. W. W. ALEXANDER, KANSAS CITY, MO.

The nocturnal skies during this month (February,) present an almost unsurpassed field of beauty and attraction, four of the largest and most resplendent planets in our system being visible in the early evening. First in the glittering array is Venus, situated in the southwest quarter of the heavens. Her motion during the month will be north and east. Seen with a telescope her disk will be gibbous, like our Moon at ten days past new; diameter on the 1st will be 12″; on the 29th, 15″. It makes almost a bound north in declination, going from 7° S. to 6° 30′ N. This planet moves around the Sun at a mean distance of sixty-seven millions of miles. Its orbit is more nearly circular than that of any of the other principal planets. It is very nearly the size of the earth, its diameter being about four per cent less than that of our globe. Next to the Sun and Moon, it is the most brilliant object in the heavens; by the last part of the month it will cast a distinct shadow of any opaque object on a white surface, such as a sheet of paper. It never recedes more than about 45° from the Sun, and is, therefore, seen by night only in the western sky in the evening, or the eastern sky in the morning, according as it is east or west of the Sun. There is, therefore, seldom any difficulty in recognizing it. When at its greatest brilliancy, i. e., by the end of the month, it can be clearly seen by the naked eye in the daytime, provided that one knows exactly where to look for it. It was known to the ancients by the names of Hesperus and Phosphorus, or the evening and morning star, the former name being given when the planet was east of the Sun and seen in the evening after sunset, and the latter when west of the Sun, it was seen in the east before sunrise. It is said before the time of exact astronomy Hesperus and Phosphorus were supposed to be two distinct bodies, and that it was not until their motions were studied, and the one was seen to emerge from the Sun's rays soon after the other was lost in them, that their identity was established. To the unaided eye she presents the appearance of a mere star, distinguishable from other stars only by its intense brilliancy.

We next come to Saturn. This magnificent planet is situated high up in the heavens; it will be on our meridian in the evening twilight. It is in north declin-

ation 19°, this makes an elevation of 70° from our southern horizon, or 20° south of our zenith. Referred to the stars, its position will be in the constellation Taurus, midway between and in line with the Pleiades and Hyades, two beautiful groups of small stars in this constellation; the principal stars of the latter are arranged in the form of the letter V, one extremity of the V being formed by Aldebaran, a red star ranked as of the first magnitude, but not so bright as some others. The Pleiades, or "seven stars," as the group is commonly called, is about 10° farther west. Really there are only six stars in the group clearly visible to ordinary eyes, and an eye which is good enough to see seven will be very likely to see four others, or eleven in all. A telescope of two inches aperture will show 120. Being elevated high above the horizon, this month will be a very favorable time for the most refined and delicate observations of this planet. It is to the rings that most of the interest of this planet attaches, the southern surfaces are opened out full to the view, the earth having nearly attained its maximum elevation above the ring plane. We may well imagine how sorely puzzled the earlier observers, with their very imperfect telescopes, were, by these strange appendages. The planet at first was supposed to resemble a vase; hence the name Ansæ, or handles, given to the rings in certain positions of the planet. It was next supposed to consist of three bodies, the largest one in the middle. The true nature of the rings was discovered by Huyghens in 1655.

There is nothing more encouraging in the history of astronomy than the way in which eye and mind have bridged over the tremendous gap which separates us from this planet. By degrees the fact that the appearance was due to a ring was determined; then a separation was noticed dividing the rings into two; the extreme thinness of the ring came out next, when Sir William Herschel observed the satellites "like pearls strung on a silver thread," then an American astronomer discovered that the number of rings must be multiplied we know not how many fold. Next followed the making out of the transparent ring by Dawes and Bond, in 1852; then the transparent ring was discovered to be divided as the whole system had once been thought to be; last of all comes evidence that the smaller divisions in the various rings are subject to change, and that the ring-system itself is probably increasing in breadth, and approaching the planet. The breadth of the entire system is 37,570 miles. In spite of this enormous breadth, the thickness is not supposed to exceed 100 miles. Of what, then, are these rings composed? There is great reason for believing that they are neither solid nor liquid; and the idea now generally accepted is that they are composed of myriads of satellites, or little bodies, moving independently, each in its own orbit, around the planet; giving rise to the appearance of a bright ring when they are closely packed together, and a very dim one when they are most scattered. In this way we may account for the varying brightness of the different parts, and the haziness on both sides of the ring near the planet, which is supposed to be due to the bodies being drawn out of the ring by the attraction of the planet. Although this planet appears to resemble Jupiter in its atmospheric conditions, unlike that planet, and like our own Earth, its year, owing to the great inclina

tion of its axis, is sharply divided into seasons, which, however, are here indicated by something else than a change of temperature; I refer to the effects produced by the presence of the strange ring appendage. To understand these effects, its appearance from the body of the planet must first be considered. As the plane of the ring lies in the plane of the planet's equator, an observer at the equator will only see its thickness, and the ring, therefore, will put on the appearance of a band of light passing through the east and west points and the zenith. As the observer, however, increases his latitude north or south, the surface of the ring-system will begin to be seen, and it will gradually widen, as in fact the observer will be able to look down upon it; but as it increases in width it also increases its distance from the zenith, until in latitude 65° it is lost below the horizon, and between this latitude and the poles it is altogether invisible.

Now the plane of the ring always remains parallel to itself, and twice in Saturn's year, that is, in two opposite points of the planet's orbit—it passes through the Sun. It follows, therefore, that during one-half of the revolution of the planet one surface of the ring is lighted up, and during the remaining period the other surface. At night, therefore, in one case, the ring-system will be seen as an illuminated arch, with the shadow of the planet passing over it, like the hour-hand over a dial of a clock or watch; and in the other, if it be not lighted up by the light reflected from the planet, its position will only be indicated by the entire absence of stars. But if the rings eclipse the stars by night, they can also eclipse the Sun by day. So in latitude 40° there occur in Saturn morning and evening eclipses for more than a year, gradually extending until the Sun is eclipsed during the whole day—that is, when its apparent path lies entirely in the region covered by the ring; and these total eclipses continue for nearly seven years; eclipses of one kind or another taking place for eight years 292 days. This will give us an idea how largely the apparent phenomena of the heavens, and the actual conditions as to climates and seasons, are influenced by the presence of the ring. The year of this planet is as long as thirty of ours, hence it follows that each surface of the rings is in turn deprived of the light of the Sun for fifteen years.

Passing on along the same line that would connect Venus and Saturn, we will find at a distance of four hours (or 60° east of the latter) the giant planet Jupiter, by far the largest planet of the system. Compared with the earth it is 1,280 times larger; it is bright enough at present, in spite of its great distance, to cast a shadow like Venus. Its apparent sidereal place will be in the constellation Gemini, nearly in a line with Castor and Pollux, at a point 9° south of the latter. This planet is surrounded by an atmosphere so densely laden with clouds that of the actual planet itself we know nothing. What are generally known as its belts, are dusky streaks which cross a brighter background in directions generally parallel to its equator. And for the most part, the largest belts are situated on either side of it, in exactly the same way as the two belts of "Trade-Winds" on the earth lie on either side of the belt of Equatorial calms and rains.

Outside these, again, we get representations of the Calms of Cancer and Capricorn, although these are not so regularly seen, the portion of the planet's surface polewards of the two belts being liable to great changes of appearance, sometimes in a very short time. The portions of atmosphere representing the terrestrial calm-belts sometimes exhibit a beautiful rosy tint, the equatorial one especially. The variations of this cloudy atmosphere lend great variety to the appearance of the planet at different times; the belts are sometimes seen in large numbers, and extend almost to the pole. Besides the belts, sometimes bright spots, sometimes dark ones, are seen, which have enabled us to determine the period of the planet's rotation, which, we know is very rapid—so rapid, that on the equator an observer would be carried round at the rate of 467 miles a minute, instead of seventeen as on the earth. It is easy to understand how this rapid rotation would break the cloud surface into belts more than with us. Although all astronomers do not agree that the surface of the planet is never seen, there are many strong reasons why it should not be seen. In the first place, Mars and the Earth, whose atmospheres are nearly alike, have nearly the same densities, while in the case of Jupiter and Saturn—the belts of which latter planet, as far as we can observe them, resemble Jupiter's—the density, as calculated on the idea that what we see is all planet, is only about one-fifth that of the Earth; and as the density of the Earth is five and a half times that of water, it follows that the densities of the the two planets in question are not far from that of water. Now, if we suppose that the apparent volume of Jupiter (and similarly of Saturn) is made up of a large shell of cloudy atmosphere and a kernel of planet, there is no reason why the density of the real Jupiter (and the real Saturn) should vary much from that of the Earth or Mars, and this would save us from a water planet hypothesis. Moreover, a large shell of cloudy atmosphere is precisely what our own planet was most probably enveloped in, in one of the early stages of its history.

In addition to the changing features of this wonderful planet itself, the telescope reveals to us four moons, which as they course along rapidly in their orbits, and as those orbits lie nearly in the plane of the planet's orbit, lend a great additional interest to the picture. In the various positions in their orbits the satellites sometimes appear at a great distance from the primary; sometimes they come between us and the planet, appearing now as bright and now as dark spots on its surface. At other times they pass between the planet and the Sun, throwing their shadows on the planet's disk, and causing, in fact, eclipses of the Sun. They also enter into the shadow cast by the planet, and are therefore eclipsed themselves, and sometimes they pass behind the planet, and are said to be occulted. Of this appearance I give below a partial table embracing only a few of the most notable that occur during the month; time used is "central" or standard:

On the 2d at 9h. 52m. 20s., Ganymede is eclipsed and reappears.
On the 6th at 9h. 41m. 57s., Io is eclipsed and reappears.
On the 16th at 9h. 44m. 40s., Callisto is eclipsed and disappears.

On the 17th at at 11h. 59m. 00s., Europa is eclipsed and reappears.

Following the same lines connecting Venus, Saturn and Jupiter, 15° farther east, we find Mars; it is in the constellation Cancer, and will be in the evening twilight, in the northeast quarter of the heavens at an elevation of about 20°, and the same distance north of east.

This is the fourth planet in order of distance from the Sun, and the next one outside the earth's orbit. Its mean distance from the Sun is about one hundred and forty-one millions of miles. It is easily recognized with the naked eye when near its opposition, by its fiery red light. It is much more brilliant at some oppositions than others, the present is not a very favorable one to see it, but yet it will exceed an ordinary star of the first magnitude. The variations of its brilliancy arise from the eccentricity of its orbit, and consequent variations of its distance from the Earth and the Sun.

Mars has been an interesting object of telescopic research from the fact that it is the planet which exhibits the greatest analogy with our Earth. The disk, even with a small telescope, can be seen to be divided into light and dark portions, which some observers suppose to be continents and oceans. Around each pole is a region of brilliant white, supposed to be snow. It must be said in favor of these suppositions, that if our Earth were viewed at the distance at which we view Mars, and with the same optical power, it would present a similar telescopic aspect. But it is also possible that if the optical power of our telescopes were so increased that we could see Mars as from a distance of a thousand miles, the resemblances would all vanish as completely as they did in the case of our Moon. This is the only planet besides the Earth of which we can be sure that the time of axial rotation admits of being determined with entire precision; it has been found to be 24h. 37m. 22.73s., this is correct within three or four hundredths of a second. The Equator is inclined to the plane of its orbit about 27°, so that the vicissitudes of the seasons are greater there than on the Earth in the proportion of 27° to 23½°. Owing to this great obliquity, we can sometimes see one pole of the planet, and sometimes the other, from the Earth.

Comet Brooks, so closely identified with the one of 1812 (i. e. Encke's) as to leave but little doubt that it is the same, was first observed September 3, 1883. It was then in the constellation Draco; it moved from this into Lyra, passing only a few degrees north of Vega in the latter part of November, it entered the Milky-Way and Cygnus, thence through the eastern edge of Vulpecala. On December 29th it entered Pegasus, passing from this constellation into Pisces on the 10th of January, and on the 15th it was on the boundary line between this and Aquarius, at this time it had attained its maximum brilliancy and was 118 times brighter than it was when discovered, and plainly visible to the naked eye. On the 22d of January it will enter Cetus, and by February 1st will be in Sculptor; its brilliancy will have faded about one-half; by the 12th it will be below the horizon all the time. The only time it will be possible to see it will be during the first week of the month, and a telescope or opera glass will be required. It will be nearly due southwest, and elevated from 10° to 15°.

SUN AND PLANETS FOR FEBRUARY, 1884.

W. DAWSON, SPICELAND, IND.

The Sun is approaching the Vernal Equinox—its R. A. being 21h. 0m. on February 1st; and 22h. 48m. on the 29th. During the month he moves northward from 17° 7′ south declination, to 7° 37′ S. This change makes February 29th one hour and eight minutes longer than February 1st; the latter being 10h. 2m. in length, and the former 11h. 10m. long.

Solar spots are waning somewhat, though they exist in very clever numbers yet, (January 17th).

Mercury is Morning Star and will be at greatest elongation west about the middle of February, when it can easily be picked up with an equatorial telescope. It will be too far south to be conspicuous to the naked eye. The very bright Evening Star in southwest is Venus, and it is now quite worth looking at. The same of Jupiter, north of east,—still forming a row with Castor and Pollux. Mars is some distance northeast of Jupiter, and may be known by its fiery redness. Its opposition to the Sun on the 1st of February will be appreciated by those who have access to very large telescopes, as being a favorable opportunity for seeing its tiny moons. Saturn is between Aldebaran and Pleiades—crossing the meridian at 7:20 P. M. February 1st, and about four minutes earlier each day afterward. Uranus is in the southwestern part of Virgo; about 4° west of the star Eta. Neptune is still about 10° southwest of Pleiades.

The 1812 comet re-discovered by Professor Brooks, September 13, 1863, has moved southeast, so as now (January 17), to be in the southwestern sky; and it is a fine little naked eye comet. It presents a grand appearance in the telescope —a large and very bright nucleus surrounded by a beautiful crown of dense hazy light, with a splendid tail 2° long from the side opposite the Sun. It will probably disappear in the southern horizon about the end of February.

GEOLOGY.

THE FOSSIL FIELDS OF SOUTHERN OREGON.

CHAS. H. STERNBERG.

In August, 1877, while working in the Loup Fork Group of northwestern Kansas I received orders from Prof. E. D. Cope to go at once to Oregon, to a new fossil deposit; I was to keep the locality a secret from all. A day or two after I was on the west bound train and there met Mr. S. W. Williston, one of Professor Marsh's collectors. He seemed to be on his way to a new locality, and

refused to tell me of his destination. I thought he might have told the conductor, and therefore on my first chance asked that gentlemen where Mr. Williston was going, and he told me at once that W. had learned of a rich locality where fossil bones of huge proportions were found, in Cañon City, Colorado,—I immediately wrote to Professor Cope, and had the satisfaction of learning a few months later that he had sent a man to this rich field about the same time that Professor Marsh had, and helped reap a rich harvest of those new and unique remains of extinct animals, great land Saurians and Dinosaurs, some of which reached a height of twenty five feet and a length of sixty feet.

On my arrival at Reading, California, I took the stage for Fort Klamath, Oregon. That stage ride was one long to be remembered, and carried me through some of the grandest scenery in America. We traveled up to the head of the Sacramento River, through virgin forests of magnificent pine, spruce, etc., that lifted their heads 150 feet in the air: long festoons of moss hung down from the branches trailing on the ground; every turn in the road showed us some new feature in mountain scenery, and at last, towering 4,000 feet above the surrounding mountains, Old Mount Shasta stood revealed in all her snow-clad greatness, a perfect cone, the most sublime of mountain forms, filling my expectations of what a mountain ought to be.

Near Denver the Rockies look like a mass of bluffs, all about the same height, while Shasta stood out alone, overlooking and master of the mighty Cascade Range that lay at his feet. They are indeed the Alps of America. Farther north Mount Hood stands guard over Oregon, and farther on Mount St. Helen rules over Washington; these cone-shaped mountains are all extinct volcanoes, and have living glaciers in their deeper cañons. Another grand piece of Nature's handiwork we passed on the route, was Castle Rock, a huge pile of gray rock which from a fancied resemblance to an ancient castle has received its name. On my arrival at Fort Klamath I was cordially received by the Commander, who took me into his home while I was at the post, and whose kind hospitality I shall not soon forget. While here I prepared the skeleton of a large grizzly bear that a gentleman had killed a short time before; this bear had killed a number of his sheep. One night he heard a commotion in his sheep pen, and seizing his Winchester rifle went out of his tent to see Mr. Bruin walking leisurely along a few feet from him; taking aim he fired and fortunately broke the bear's neck.

Here I also caught a large number of mountain trout. They are as savory as our eastern trout, but are not as gamy. It is no trouble to catch them, I baited a hook with a worm, and standing near a deep hole in which numbers were gathered, threw in my line: they bit quickly, in sight of me, and I caught a dozen or more in this one place.

At Klamath I hired an assistant and bought my riding and pack animals. The Government supplied me with saddles, tent, etc. I could get no guide, so trusting to a Government map, we started for Silver Lake. My map traced Sprague River that emptied into Lake Klamath, near the post, to its head in Silver Lake. My plan, therefore, was to follow up the river. As I was cross-

ing a large Government bridge on Williamson River a number of Indians came up to me and demanded $2.00 toll, this I refused to pay. I learned afterward that these Indians made a living by collecting toll from people crossing this bridge. After following Sprague River for about fifty miles I found it rose in a small range of hills and I was at my wits end as to what to do; my only guide had proved false. At last, I resolved to go north. I was in a country only occupied by Indians and wild animals. I came to a place where the trail I was following forked, one going directly north and was but little traveled, the other, a well beaten trail, led a little west of north. While debating as to the best course to pursue, an Indian boy came along driving two pack ponies, or cayuses, as they call them. He took the large trail, I asked him where he was going and he told me to Sican Valley to a sheep ranch. I had been told that I would go through this valley and by a sheep ranch on my way to Silver Lake, I therefore followed the Indian. After going about five miles the trail came to an end in a thick forest, at an Indian encampment; a number of braves in war paint came out and told me I was lost, and that they would show me the road for $2.00. I was so indignant at having been cheated so that I refused to pay them anything, and started east. Fortunately, just as the sun went down we found the trail we had left. Here we ate the last of our provisions, as the night before an Indian had stolen our bacon that we had packed under a lot of tinware in the bottom of a box near the head of our bed, and the bread had fallen off our pack and was lost. Next morning, bright and early, we started without breakfast in hopes of reaching the sheep ranch, which we luckily did just before dark, very hungry and tired; here a good cup of coffee, some hot bread and mutton-chops soon made us forget our past hunger and dangers, and we were glad to learn that another day's journey would bring us to Silver Lake, which we reached next day. Here we heard all about the wonderful bone-yard that had been discovered by a stockman in a desert twenty-eight miles from here.

Next day, accompanied by the postmaster as guide, we started for the fossil fields and reached a house eight miles from the locality that day, where we camped for the night. It took all next day to reach our destination, as we had to find our way through a sage brush desert. We had a wagon along and it was slow work. The fossils we were in search of were of quite recent species, some in fact, were of existing ones. The bones lay scattered around a small alkaline lake and were all exposed, resting on a bed of clay. They had been covered with loose volcanic sand and ashes which the wind had drifted away and piled in great heaps sixty feet or more in height. These sand drifts were covered with wind-marks and looked like newly harrowed fields. There were numerous hillocks, from a few feet to eighteen or twenty feet high, the summits of which had been protected by a patch of sage brush and the sides laid bare and rounded by the wind. We pitched our tent and hitching our pony to a sage brush hauled it into camp, and so repeated this till a large pile was gathered. Early next morning we were busy gathering together the loose bones and placing them in piles; we put them on our pack-horses and carried them to camp. They were well preserved;

but unfortunately none of the skulls were preserved; they had been broken beneath the feet of countless deer and antelope that had come to the lake for water. We got a great many teeth and bones. They were all scattered. One party under Prof. Condon, of the State University, had been at the locality before us. The mammalian bones were three species of the Horse; three of the Llama; one new species of a sloth, *Mylodon;* the elephant; a beaver-like animal, and some carnivores. We got great quantities of fishes that varied in size from a trout to a salmon or larger; also a great many bones of birds in size from a sand-piper to a stork. Among them was the Canadian goose. There were piles of land-shells that looked like snow-drifts. The bones were but little petrified and were of the pliocene age. The animals had all doubtless perished under a storm of volcanic ashes and sand from an active volcano near by.

We found numbers of arrowheads, polished and made from volcanic glass or obsidian. We had thought at first that they might be contemporaneous with the bones, but I found near the deposit, between some huge sand banks, in the remains of an old Indian village, near which one arrow-maker had his abode, great quantities of chips of obsidian, perfect arrowheads and those partly finished, with drills, knives, pestles and mortars, and a pile of whitened rabbit and other bones. We found part of an Indian skull also. One peculiarity I noticed in the desert was that all the springs were on the tops of rounded knolls, which led me to think that perhaps water would come to the surface from artesian wells. If that be the case, this country will one day become a fertile land. We got over a thousand pounds of fossil bones from this locality, all of which have been described by Prof. E. D. Cope in the Bulletins of the U. S. Geological Survey.

FLINT CHIPS.

G. C. BROADHEAD.

In the January number of the REVIEW Dr. Child asked about "gun-flints," I therefore thought I would chip off a few notes concerning *flint* and other somewhat similar rocks.

Flint is a uniform impure variety of silica allied to chalcedony. It is cryptocrystalline and of opaque dull colors, generally grayish, smoky-brown and brownish-black; is easily broken and breaks with a flat conchoidal fracture and sharp, cutting edge. It is feebly translucent, of a homogeneous texture, bears polishing but possesses little lustre.

The flint of the chalk formation largely consists of the remains of *infusoriæ* and sponges, and recent investigations have in a great measure confirmed the theory that most flint concretions and chert concretions are remains of sponges. —the fossil *spiculæ* of sponges; they have in fact been classified and assigned to genera and species.

Hornstone resembles flint but is more brittle. Chert is a variety of horn-

stone and is very abundantly interstratified with the rocks of Missouri. Although much of it is flint-like and is even called flint, still it is scarcely proper to apply the term "flint" to our Missouri chert beds, but they may sometimes be termed hornstone.

The upper carboniferous incloses chert of different colors and varieties. At Kansas City and other places where the same strata occur, we find beds of black chert and also of light brown chert. Some of the beds being quite silicious, inclose some pretty fossils whose composition is often a milky looking chalcedony.

The lower carboniferous includes many chert beds. The gray Keokuk limestone beds include numerous white chert concretions. The upper Burlington beds consist near the top of seventeen to twenty feet of alternate beds of white chert and red clay. The Chouteau beds occasionally inclose concretions of white and bluish chert.

The Magnesian limestone series of southeast and southern Missouri abound in concretionary chert beds which (in the second magnesian limestone) are bedded in shaly strata separating them from the limestones. In the third magnesian limestone occur some thick chert deposits which sometimes can be traced many miles. Such beds I have found along the Osage and Gasconade. These are generally of a white or gray color, sometimes a grayish blue and rarely a flesh color: they are sometimes beautifully banded forming coarse agates. The concretionary chert beds often assume curious forms. The concretionary chert beds or beds of concretions generally occur along a well defined line either connected or separated from each other but arranged parallel to the inclosing limestone strata. These lower magnesian limestone beds also inclose many pretty öolitic chert beds, the öolites are often as small as the roe of a herring.

We also often find very pretty round concretions which when broken show that they were formed in parallel concretionary bands, the bands sometimes are of different shades of color. The interior, though generally solid sometimes contains clay. Our fossil woods are generally of some variety of chert, hornstone or chalcedony. Some from Colorado and Idaho are a variety of opal. Beautiful chalcedonic wood is found in Colorado. Moss agate in western Kansas and Colorado. The fossil silicious wood of the carboniferous is generally of a black color, which is due to the presence of carbon. This is also further traversed by chalcedonic veins, and small cavities are sometimes lined with minute crystals of quartz.

The cretaceous formation in England incloses rounded nodular masses of chert of various sizes and shapes and colors, white and black. These are sometimes formed in concretionary bands of black and white, and exhibit markings derived from organic bodies.

When flint is calcined it becomes white, hence its color is attributed to organic matter derived from inclosed fossils. Quartz has been formed by organic agency, for example, from spiculæ of sponges or from plants; it is also formed by the agency of water as flint concretions, or by plutonic agency.

Potter's clay is chiefly composed of silica.

Flint was formerly employed in the manufacture of finer varieties of glass, which was termed "flint-glass."

Flint is used in the manufacture of fine earthenware, being for this purpose first calcined, then thrown into cold water when it is easily broken, and it is then ground into powder.

It has long been known that flint would strike fire with steel, and it has been thought that during the process a chemical combination of silica and iron takes place, causing great increase of heat. Pliny informs us that Clias was the first to strike fire with flint or to utilize it.

Before matches were invented, flint with steel and tinder were used for making fires, and the use of gun-flints immediately preceded that of percussion caps. Percussion caps began to be used with fire-arms between 1820 and 1830, and were entirely adopted by the British army by 1840.

When a boy, I owned a gun with a flint-lock which my father had altered to a percussion lock. That was between thirty and forty years ago.

The material of which gun-flints were made was chiefly derived from the English chalk beds. In the selection of gun-flints the best nodules were chosen, selecting those whose form was more nearly globular. They should have a greasy lustre, be particularly smooth and fine-grained. The colors were some shades of brown and uniform throughout. The translucency should be such as to render letters legible through a slice one-fiftieth of an inch thick, and the fracture smooth and uniform, and slightly conchoidal, the last property being very essential.

We copy from Ures' Dictionary of Arts and Sciences the mode of working the flint. The tools used were:

1. An iron hammer of one to two pounds weight with a square head—a steel hammer being harder would shatter the iron too much.

2. A well hardened steel hammer of ten to sixteen-ounce weight having two points, the handle being so inserted that the points of the hammer are nearer the hand of the workman than the centre of gravity of the mass.

3. A disc hammer, or roller, being a small steel wheel two and one-third inches in diameter, and twelve-ounce weight, having a handle or axle six inches long passing through its centre.

4. A steel chisel.

5. A steel file to sharpen the chisel.

The process of making flints was as follows:

1. The workman seated upon the ground places the nodule of flint upon his left thigh and with slight strokes of his square hammer he divides it into pieces of about one and a half pounds weight.

2. The workman holds the lump in his left hand and strikes with his pointed hammer upon the edges of the great planes produced by the first breaking. Scaly portions are thus detached nearly one and a half inches broad, two and a half inches long and one-sixth of an inch thick, and slightly convex below.

3. The workman fixes on a border for the striking edge, then the two sides

that are to form the lateral edges, as well as the part that is to form the back. It is placed on the edge of the chisel in such a manner that the convex surface of the flint which rests on the forefinger of the left hand is turned towards that tool. Then with the disc hammer he applies slight strokes to the flint just opposite the edge of the chisel underneath and thereby breaks it exactly along the edge of the chisel.

6. The stone is then turned and the edge of its tapering end is placed upon the chisel, and the process of trimming and sharpening is completed by five or six slight strokes of the disc hammer.

The whole time of making a gun-flint occupied less than a minute. If the flint balls are good a workman will manufacture 1,000 flints in a day, but if the quality is poor about 500.

I do not know whether there have been any manufactories of gun-flints in the United States; certainly they were manufactured in Europe, especially in England.

The worked "flints" of the stone age, although generally termed "flints," were made of various kinds of silicious rock including common flint, chert, hornstone, quartzite, chalcedony, agate, porphyry, jasper, and obsidian.

The California Indians readily manufacture glass bottles into arrow-heads.

The arrow points found in Missouri are of quartzite, chert, hornstone, and porphyry, but chiefly of chert, generally of a white color, but sometimes reddish tinted, others are brown, black, or gray, or bluish and white.

I have found localities where evidently a number had been made, for the flints were in every stage of perfection; some very perfect, others from which only a few flakes had been chipped off. Pits have been found where the prehistoric people had probably quarried flints, for they did not seem to be old mineral shafts, no mineral at present being found there.

NOTE ON A NEW MINERAL TO CENTRAL KANSAS.

WARREN KNAUS.

In November, 1882, while in Saline County, my attention was called to a crystallized mineral supposed to be a form of gypsum. I took a specimen to the Agricultural College and it proved on analysis to be *Celestite* (Sulphate of Strontia) —a mineral then little known in the State, and not found in Prof. Mudge's Catalogue of Kansas Minerals.

The locality in which the mineral is found is the SE. ¼ of Sec. 30, T. 14 S. and R. 2 W., being on the extreme western edge of the Permian Group, bounded at this point by the Smoky Hill River.

The Celestite occurs in crystals, in the strata of the limestone, dipping at some points to the surface of the water, and rising at other points from ten to twenty feet above the surface. The mineral also occurs in massive nodules in

the bottoms of ravines, but is less free than the crystallized forms. The crystals are of all sizes, varying from needle-like points to crystals one and a half inches in length and a half inch in diameter. Many of the crystals are perfectly transparent, others are opaque.

There are, I believe, but two other localities in the State in which this mineral is found: one near Manhattan, where it occurs in the massive form, the other locality is near Valley Falls.

CHEMISTRY.

KAW WATER AT LAWRENCE, KANSAS.

PROF. E. H. S. BAILEY.

A sample of the water from the Kansas River was taken on October 13th, one day after a rain, at a point one-half a mile above the bridge. A sample was also taken on the same day from a well in West Lawrence, at a point near the river bank. The river water was turbid, and was allowed to stand till the sediment was deposited, so that an analysis of the clear water was made. For the execution of the following analyses, I am indebted to Mr. T. W. Miller, a student in the Chemical Labratory of the University. The amounts are expressed in grains per gallon:

	River Water.	Well Water.
Silica, (sand)	1.370	0.211
Chloride of Sodium, (salt)	6.677	10.859
Sulphate of Lime	2.440	9.498
Bicarbonate of Lime	16.122	29.908
Bicarbonate of Magnesia	3.527	8.183
Bicarbonate of Iron	Trace.	0.593
Bicarbonate of Soda	Trace.	Trace.
Organic Matter	0.770	7.873
Total Solids	30.906	67.125

It will be noticed that the well water has more than twice as much residue or mineral matter as the river water. This residue is not considered as necessarily injurious; but from an economic point of view, the river water is much superior, as these solids in this case make the well water much harder than that of the river. Carbonate of lime and magnesia render water "temporarily hard," that is, the water can be cured by appropriate reagents. Sulphate of lime, on the other hand, makes the water "permanently hard." The well water contains twice as much carbonates as the other, and four times as much sulphate of lime.

Well water therefore uses up much more soap than river water. As an instance of the saving in this item of soap, it was estimated that $180,000 was saved annually in the City of Glasgow, after the introduction of the pure water of Loch Katrine.

But it may be urged that only cistern water is used for washing. This, however, very often fails, especially in a dry season, when well water must be substituted.

I believe the suggestion has been made that water be pumped from a well near the river bank, so that river water may be used, and yet it may be filtered. The suggestion is, in the main a good one, but the well must be literally on the bank, or the hard water will filter in through the surrounding rocks, and the water will thus be deteriorated. If a convenient place can be found either on the south or north bank of the river, where there is a sandy shore, the wells might be dug in this and a supply of filtered water be thus obtained. Essentially, this plan has been carried out with success in many cities. The unfiltered water even, is for many reasons, superior to our well water.

A word upon the quality of the latter. Many of these wells, I am informed, have been tested by a competent chemist, and have been pronounced unfit for domestic use on account of so much organic matter. Furthermore, a well that is good this year, may be bad the next, for there is a constant menace in the fact it is not possible to tell how soon the surrounding soil will be permeated with filth and contaminate the well. It is not necessary to enlarge on this point, for it is everywhere conceded that there is constant danger of the spread of zymotic diseases through the medium of impure water.

It will be noticed that the well water examined contained 7.873 grains of organic matter, while the river water contained only 0.77 grains, an immense difference in favor of the river.

Cistern water is often very impure, because the rain washes into it the decaying matter from the roof. Of course, if collected from slate or tin roofs it has hardly any superior in regard to purity.

Of the various sources of water supply at hand, the river, therefore, seems to be the safest, and will in time prove the most economical. As to its purity, there is no danger of injury to the water from sewage from towns above, for water happily purifies itself from such material in running a few miles. A distance of five miles produces a marked change in the character of the water in a swift running stream.

Lawrence is much more favorably situated in this particular than very many cities. Boston water contains 0.81 grains of organic and volatile matter; Philadelphia, 1.2 grains; New York, 0.67; Chicago, 1.06; London, 0.87; Paris, 1.00.

In regard to total solids, the amount in the waters of the cities above mentioned varies from 3.11 grains to 16 grains. It is to be expected that the Kansas River would have an abundance of these substances, fed as it is by water that has flowed over our extensive limestone deposits.—*Lawrence Morning News.*

WONDERS OF PHOTOGRAPHY.

Twenty years ago, to have one's likeness taken was a trying ordeal. The patient to be operated on was placed in as strained an attitude as the ingenuity of the photographer could devise; his head fixed in something resembling a vise; he was cautioned not to wink for a length of time which seemed to depend on the state of the photographer's temper; and then in the course of a few weeks he received pictures of a staring idiot supposed to be himself. All who were at all proud of their personal appearance—all women and most men—were disgusted with the art. Now all is changed; the operation is generally over in a second or two; freckles, pimples, and cross-eyes are improved away, and everybody is surprised how comely he is. This rapid progress in the art of photography is to some extent due to improvements in lenses and various mechanical appliances, but more especially to the discovery that the salts of silver in combination with gelatine yield a far more sensitive plate than could ever be obtained by the old collodion process.

Within the last two years some remarkable photographs have been taken which show the wonderful perfection to which the art has attained. Likenesses of restless children, crying or laughing, are now so common as hardly to need mention; even the act of kissing, transitory as it is, is sufficiently prolonged to enable a photograph to be taken, the momentary rest, when lips meet lips, are enough for the artist's purposes. But movements far more rapid than the act of kissing (which, after all, is often not so very transitory) are now seized by photography. Athletes performing in mid-air, birds flying, the course of projectiles, waves breaking on the coast, have all been photographed with a definition and clearness that leaves little to be desired. Photos of the Irish mail, rushing along at the rate of forty-five miles an hour, show the outlines perfectly defined, while the spokes of the engine-wheels are plainly delineated, proving the operation to have been so rapid that the wheels had not time to move any appreciable distance. Perhaps, however, the most remarkable photographs of moving objects are those obtained by Mr. Muybridge of horses running and jumping; in these, positions of the limbs are shown which are far too transitory for the human eye to detect; what the eye sees in watching a horse running is an average of the successive positions assumed by the horse's legs; photography alone can give an accurate idea of their position at any definite point of time. The attitudes shown in photographs seem at first sight to be absurd, and certainly differ very much from representations by engravers and painters; photographs show the real positions at certain moments of time, while painters depict, and rightly too, the apparent positions.

To the astronomer the art is invaluable, and some of the most remarkable discoveries in astronomy have been made by its aid. Large photos of the Sun are taken every day it is visible at Greenwich and elsewhere, and thus a perma-

nent record of the exact size and shape of every sunspot is obtained; these, when compared with electrical and other meteorological conditions, will help to settle the question whether and in what way the sunspots affect the weather. To such a perfection has the manufacture of gelatina-bromide of silver attained, that M. Jansen, of Paris, photographs the Sun in less than one two-thousandth of a second. Again, the solar corona, as to the nature of which such varied speculations have been rife, is only visible during the very few minutes that a total eclipse of the Sun lasts, and the observations that can be made in so short a time are necessarily very imperfect. Recently, however, Dr. Huggins has succeeded in photographing the corona without the intervention of an eclipse. The corona is especially rich in violet rays; now, the eye is less sensitive to small variations in the violet rays than it is to the other colors of the spectrum, whereas the violet is just what photography deals with most effectively. By cutting off the other rays, Dr. Huggins has succeeded in photographing the corona by means of its own violet light, and that, too, at a time when hitherto observations have been impossible. When his method is perfected, astronomers will be able, with the help of the camera, to study the corona and solar protuberances at their leisure.

The recent transit of Venus afforded a fine opportunity for calculating the distance of the Sun, and it is expected that, with the assistance of the hundreds of photographs obtained, the distance of the Sun from the earth will be calculated to within 300,000 miles. The numerous comets, too, have not been allowed to pass without leaving their images behind, which show their shapes and positions far more perfectly than has hitherto been possible. But perhaps the most remarkable achievements are the photographs of spectra of stars and nebulæ. Not long ago it was hardly possible to photograph stars of the fourth or fifth magnitude, and even the brighter nebulæ shone with far too faint light to enable photographs to be taken. But, recently, not only have the fainter nebulæ and stars, as low as those of the fourteenth magnitude, which are only visible through most powerful telescopes, been photographed, but their light, even when dispersed by the prism, has still been strong enough to leave its impress on the sensitive plate. Dr. Huggins and Professor H. Draper have each succeeded in photographing spectra of nebulæ and stars of the twelfth magnitude, and thus determining some of the elements contained in worlds so distant from us that their light, travelling 186,000 miles per second, has taken thousands of years to reach us. Such photographs are especially useful, because they show the faintest lines in the spectra which have hitherto escaped the most practised eye.

Hardly less remarkable are some of the discoveries of Captain Abney, the prince of photographers, in his experiments on the infra-red of the spectrum; he has recently shown that between the earth and the Sun, and quite outside our atmosphere, there exist accumulations of benzine and alcoholic derivatives. Alcohol in temperance drinks, alcohol in rainwater, *alcohol in space*, alcoh l everywhere.

Again, in meteorology the art of photography will prove to be of immense use. A regular system of photographing the clouds by means of a specially

made cloud-camera, which acts automatically, has just been commenced. The form and disposition of clouds have always been regarded as an index to the weather, and weather records compared with cloud-photographs will doubtless afford valuable information and assistance in weather prognostications.

To the geographer and ordnance surveyor the camera will soon be regarded as an indispensable part of their outfit. The tedious operations of making sketches of a district will be obviated, and perfect pictures with hardly a chance of error will easily be obtained.

To the medical man too, and the chemist, photography is found to be a valuable assistant. At the Glasgow Medical School the successive stages of surgical operations, sections of tumors and diseased structures, and in fact any remarkable forms of disease, are photographed, and the prints shown to medical students and distributed among the profession to assist in the diagnosis of rare forms of disease. Dr. Lennox Brown and Mr. Cadett have recently got some wonderful photos of the interior of the larynx. By an adjustment of mirrors in the mouth and the electric light to illuminate the throat, they obtained perfect pictures of the various positions of the laryngeal muscles *during the act of singing;* and we may expect that such photos will be found of great value, not only in the teaching of classes of medical students, but as aids to the study of the mechanism of the voice. Further, Dr. Koch has recently got some remarkable photographs of bacteria and bacilli by the aid of the camera and microscope; and here, again, such pictures may be made of incalculable value in disseminating a knowledge of these minute but most formidable enemies of mankind.

In medical jurisprudence, when it is stated that the crystals formed by the one-thousandth of a grain of arsenic have been successfully photographed, it will easily be seen that, in cases of poisoning, photography may prove a very valuable assistant in the detection of crime. A novel use of the art is now being made in the Municipal Laboratory of Chemistry at Paris; photographs of chocolate, tea, coffee, pepper, milk, cheese, etc., as seen through the microscope, are taken and distributed; and, by comparing samples of such articles with photos of the pure article, an easy method is afforded, even to non-professionals, of detecting adulteration.

Photography is utilized by the microscopist in other directions. Accurate views have been secured of the most minute objects, just as they appear under the most powerful microscope. Photos of minute diatoms, polycystina, infusoria in motion, bacilli, and trichini have recently been obtained by the writer of this article under a power of 1000 diameters. The cilia of animalculæ, blood corpuscles, the microscopic structure of bone and tissue are shown most distinctly, and details are seen easily which often escape the eye in microscopic examinations. A large photo, six inches in length, of a small fly's tongue measuring about one-seventieth of an inch, shows the hairs and various markings with remarkable clearness. A simple calculation shows this photograph to cover an area 176,000 times as large as the original object. Again, views of the internal structure of wood show conclusively whether the wood is weak or strong; in

strong wood the concentric rings appear close in texture, while the radial plates are numerous, broad, and thick. It has even been suggested that such photos migh be used as trade advertisements. The internal structure of metals, too, has been examined by the joint aid of the camera and microscope; laminæ of the metals are reduced to extreme tenuity by the action of acids, and when sufficiently translucent are photographed through the microscope; gold and silver are said to have a fibrous structure, while tin is granular.

Till recently, no one would ever have dreamed of applying photography to acoustics; but it is now possible to photograph sound, or, speaking more accurately, sound-vibrations; and Professor Boltzmann is now announced as the discoverer of what at first might well be regarded with incredulity. The sound-vibrations are communicated to a thin platinum plate, and the movements of the plate, after being magnified by a solar microscope, are reflected on a screen and photographed by rapidly drawing a sensitive plate across the image. Every letter when pronounced gives a separate and distinct impression, the vowels showing regular undulatory vibrations, while the consonants give curves and lines of very varied forms. The uses of an arrangement like this may be innumerable. We can almost imagine that when the process is perfected, eavesdroppers and spies will have a very easy time, and need to run no risks in order to obtain secret information; a small instrument secretly placed in a room, and acting automatically, may copy down every word spoken; nay, it is far more chimerical to expect that photography may one day take the place of short-hand reporters.

But besides all the varied ways in which photography has been utilized in science, it has miscellaneous uses without number, and especially noticeable are the ways in which the British and foreign governments have found it serviceable. No army is now ever despatched on service without a full equipment of photographic requisites. In reconnoitering and surveying the enemy's positions and intrenchments, it was formerly necessary to have sketches made; considerable time was needed, many dangers incurred, and after all, important details were often accidentally omitted. Now the photographer accompanies the reconnoitering party, and in a second or two he secures views which show the exact positions of the enemy's works, without a chance of mistake. Such photos were found of great use in the recent war in Egypt.

Again, during the last siege of Paris, it is well known of what enormous value the pigeon post was. The beleaguered Parisians were able to keep up correspondence with their friends outside, in spite of the German army. Letters and despatches were printed on a large sheet which was then photographed to a very small scale on pellicles of six by two centimetres in dimensions; and these, being tied to the legs of trained pigeons, were carried over the heads of the Germans safely to their destination. The small photos had then only to be placed in an enlarging lantern, the letters transscribed and sent to the various addresses. The Germans have now established a regular system of pigeon-post in all their large towns, in the event of war.

At the government dockyards, when experiments were being made with torpedoes, the aid of photography was invoked. Rapid views of the torpedo explosions were taken, showing the upraised fountain of water and registering the exact height to which it was thrown. Views of rocks, buildings, or old vessels being blown up by dynamite, show the fragments as it were suspended in the air, the artist being able to expose his plate precisely at the moment required. At Shoeburyness a regular staff of artists was employed in photographing the effects of artillery experiments against iron and steel armor-plates. Again, in many of our prisons, portaits of all prisoners of a certain class are regularly taken, and, if necessary, produced by hundreds and distributed throughout the country. The detective camera, a small instrument which can be held in one hand, may be of incalculable use in obtaining portraits of any suspected persons in the streets, and in this way identification of criminals might be much facilitated.

Recently, quite a novel use has been found for photography. The Chinese, who in their own way are an extremely enterprising race, are troubled with a language which is a stumbling-block not only to foreigners but even to themselves. The number of signs or letters is so great that an ordinary printer's compositor would be perfectly bewildered; his type case would be a wilderness of boxes; in fact, to print a newspaper in Chinese would be nearly impossible. An enterprising publisher, however, has recently hit on the plan of having one copy of a newspaper written out and then multiplying the copies by photography, using one of the many mechanical photographic printing processes.

But to enumerate all the wonders of photography is impossible: one more must suffice. It has been found practicable, under certain conditions, to photograph *invisible* objects. It is well known that in the spectrum of white light there are rays which are quite invisible to the human eye: we refer to the chemical rays beyond the violet end and the ultra-red or heat rays. But the eye is far from perfect, and the rays that it cannot see can still be rendered perceptible by other means; for instance, bisulphate of quinine placed in the invisible chemical rays is at once rendered fluorescent. In a similar way, Captain Abney finds that the bromide of silver used by the photographer can be so modified as to become sensitive to the invisible ultra-red rays; and we are told by Mr. Proctor that he has "taken the photograph of a kettle of boiling water *in the dark* by means of its own radiation." In some of the photographs of the great nebula of Orion are clearly seen traces of certain dark bodies in space, while they are invisible through the telescope; and it is at any rate not within the region of absurdity to suggest that photography may some day reveal to us the existence of worlds enveloped in perpetual darkness—suns, perhaps once as bright as ours, but whose light has been dimmed by the lapse of millions of years; stars and systems which are no longer visible, but which still move in space in accordance with the unfailing laws of the universe.—*Cornhill Magazine.*

PROGRESS IN ARTIFICIAL LIGHTING.

The vast improvements which have taken place in the production of artificial light in recent years—improvements which bear to a considerable extent upon the hygienic aspect of the question—make it especially desirable to bring the subject before the public. The introduction of the electric light has had the result of stimulating invention in gas lighting, and there have been recently introduced new methods of gas lighting which bid fair to retard the introduction of the electric light for domestic use. Every form of matter when sufficiently heated has the power of emitting rays of light, and thus becomes self-luminous. This condition is termed incandescent, and the self-luminous worlds, as the Sun and fixed stars, are, doubtless, in a condition of intense incandescence.

All artificial sources of light depend upon the development of light during incandescence. For the illumination of our streets and houses at night we have hitherto made use of a combustible gaseous combination of carbon and hydrogen, which forms the chief constituent of ordinary coal gas. When this hydrocarbon burns—that is to say, when its elements unite with the oxygen of the air—it undergoes partial decomposition and evolves heat. Carbon is separated in the solid state, and floats, in a finely divided and incandescent state, in the interior of the burning vapor, and this constitutes the flame. The presence of these particles of carbon may be easily shown by holding any non-combustible body in the flame, when the carbon in fine powder will be deposited upon it, forming a layer of soot. The combustion of the particles of carbon takes place at the border of the flame, where they are first brought into contact with the oxygen of the air, but if the supply of oxygen to them be insufficient in quantity, they escape in a partially unburned condition in the form of a dark cloud, and the flame is said to smoke. The brightness of the flame is owing to these solid incandescent particles, for the burning gas itself possesses only a feeble illuminating power. It would, moreover, appear that the luminosity of a flame is due to the heat of the flame, and Dr. Frankland has shown us that hydrogen or carbon monoxide, when burned with oxygen under a pressure of from 15 to 20 atmospheres, yields a luminous flame.

No doubt the Bunsen burner gives a smokeless and non-luminous flame, although it cannot be said that the flame of the Bunsen burner is in any sense less hot than a luminous gas-flame. In the Bunsen burner ordinary gas conducted through India-rubber tubing streams into the tube of the burner. Air enters, however, through two openings, and mixes itself with the gas in the interior of the tube. If the mixture issuing from the tube be ignited, it burns with an extremely feeble flame, which deposits no soot on bodies held in it, for new oxygen is admitted not only to the border of the flame, but throughout its whole mass, and the carbon is accordingly burned into carbonic acid before it can separate in the solid form, so that the flame is composed of incandescent

gases alone. Its illuminating power is very feeble. The feeble illuminosity of the Bunsen flame appears to be due to a number of causes. We have, first, a rapid oxidation of luminiferous material to gases of feeble illuminating power by the oxygen in the admixed air; in the second place, we have the presence of diluted gases, which, of themselves, reduce the illuminating power; and, thirdly, we have heat withdrawn by the indifferent gases, as nitrogen, and the products of combustion, carbon dioxide and water.

We cannot say that the loss of luminosity is due to any one of these causes acting singly. On the other hand, in consequence of the more perfect combustion that takes place, it is used as a heat-producing flame and its temperature can be still further raised by a short conical chimney, supported on six metal arms arranged in the form of a star. If a solid body be introduced into this feebly luminous flame, such, for instance, as a piece of a platinum wire, the incandescent metal glows with a brilliant light, and, inasmuch as it is smokeless, it will not act destructively on the platinum in the same manner as a smoky gas flame will do. The luminosity of a Bunsen burner can be restored by shutting off the entry of air, either by closing the holes with the finger or by the rotation of a slide which covers them. The light then becomes much more brilliant, with abundant formation of smoke.

The flames of candles and lamps, whether the substance burned be tallow or wax, rape oil or petroleum, do not differ essentially from that of an ordinary gas burner. The same hydrocarbon which is the essential constituent of common gas is the source of light to them. The hot wick which draws up the fluid material about to be burned plays the part of a small gas factory, the produce of which is used on the spot, the only difference being that coal gas is always purified before it is consumed, whereas the extemporaneous gas of a candle or lamp is consumed without being purified at all. On the other hand, the tallow, wax and oil contain the carbon and hydrogen in a purer and more concentrated form than the coal from which ordinary coal gas is made. The flames of candles and of lamps all owe their luminosity to the incandescence of particles of carbon floating in them, and the reason why one description of candle or lamp is more smoky than another is because the supply of air in the smoky one is not sufficient to produce adequate combustion.

A petroleum lamp burns, in the first instance, with a dull, murky flame, giving off a large quantity of smoke, but it acquires a high degree of luminosity when the glass chimney is applied, for the presence of the chimney causes a strong draft, supplying the air requisite for the thorough combustion of the gas with which it was previously intermingled. The brilliancy of a petroleum flame is thus materially exalted by an increased supply of air, while that of a Bunsen burner, as has just been seen, is almost abolished by the same means. The contrary effects observed in these two cases admit of an easy explanation. In the latter instance, the amount of air supplied is so great that scarcely any of that separation of the particles of carbon takes place which is so necessary in order that a bright light should be produced. But in a petroleum lamp the introduc

tion of a moderate quantity of air, by effecting the combustion of the superfluous particles of carbon, causes a higher degree of heat, and consequently a more lively incandescence and illumination of the still remaining particles. From this it is obvious that in order to obtain the highest illuminating power of a flame in which hydrocarbonaceous compounds are undergoing combustion, the regulation of the supply of air is essential. The more perfect combustion is also essential to the maintenance of the purity of the air of the room. In a hygienic aspect it is also essential that the compounds used to produce light should be as pure as possible, and during the last twenty years vast improvements have taken place in the methods of purifying gas, so that now the London gas is almost entirely free from sulphur and its compounds.

We will now proceed to consider in what way candles, oil lamps and gas, as sources of artificial light, affect the air of a room. The effect caused on the air of a room by combustion is, first, to diminish the oxygen, and, secondly, to increase the carbonic acid and produce water and ammonia. If the combustion is imperfect the effect is also to create carbonic oxide and soot, as well as to disperse into the room any impurities which the material which is used for illumination contains, besides the carbon and hydrogen which are necessary for purposes of illumination. If we look back at the graduations of improvements which have taken place in artificial lighting, we find that each successive step has been of advantage to the purity of air. Probably the earliest known means of lighting was the torch, cut from pitch-pine, and sticky with exuded rosin. It gave a large red flame, and volumes of smoke which condensed into small particles of soot, colloquially termed "blacks," which adhere to faces and clothes with surprising determination, and may give some idea of the eminent discomfort experienced in a hall lighted, like the Walhalla, with pine splinters. Substituting a rope for a splinter, and saturating this with pitch or rosin, we have the link that still, in foggy weather connects us with the past.

The lamp of the type found in Pompeii probably succeeded these cruder means of lighting. The wick of oakum, or flax, or cotton, dipped in oil or bitumen, gave a smoky flame, because no effort was made to bring a sufficient current of air to the wick to assist the combustion. These lamps were often fed with scented oils, which are said to have rendered the air heavy with their perfumes, which shows that they gave out a considerable amount of impurity. You may imagine the state of a room the morning after a symposium, when, perhaps, a dozen lamps had been burning for six hours, smoking fearfully, without the least appliance for the escape of the heavy carbonaceous fumes. Indeed, it was one slave's recognized duty to go round in the morning wiping the sooty pictures and statues. The Argand burner with its chimney, and the air brought so as to increase the combustion of oil lamps, was a great step in advance, and effected a most marked improvement in the purity of the air of a room.

Candles with a wick made of the pith of rushes covered with wax or tallow are mentioned by Martial and Juvenal. These must have resembled the smoky rush-light of our more immediate ancestors, and the tallow candles which many

of us remember as of yesterday diffused impurities in the air far greater in proportion to the light they afforded than any modern form of light. The last fifty years have witnessed vast improvements in the wicks and in the materials of candles, so that their smokiness has been gradually much reduced. Indeed, as regards the contamination of the air of a room, it may be accepted as an axiom that the more imperfect the combustion in any source of artificial light, the more deleterious the effect on the air of the room. We complain of gas, but if we were satisfied with the same amount of light in the case of gas which we obtain with candles or lamps, we should not find the vitiation of the air more convenient with one than the other.

An experiment mentioned by Mr. Clegg in his treatise on the manufacture of gas may be mentioned here in illustration of this. The flames of several combustible bodies that give an amount of light equal to it, were burned separately in given quantities of atmospheric air, and the times were noted at which the flames were extinguished by the contamination of the air. The following were the results:

	Minutes.
Colza oil was extinguished in	71
Olive oil was extinguished in	72
Russian tallow was extinguished in	75
Sperm oil was extinguished in	76
Stearic acid was extinguished in	77
Wax candles was extinguished in	78
Spermaceti candles was extinguished in	83
Coal gas (13 candles) was extinguished in	98
Cannel gas (28 candles) was extinguished in	152

The preceding numbers may be taken to indicate the comparative salubrity of the several illuminating materials, from which it appears that the atmosphere of a confined room lighted by cannel gas would support life twice as long as the atmosphere of the same room lighted equally with tallow candles. Nor does the complaint that is frequently made of the heat of rooms heated by gas afford much better foundation for an objection to gas lighting than its assumed insalubrity. The fact may be true that a room lighted by gas is hotter than when lighted by candles, but the cause is to be attributed, not to the greater heat-giving power of the gas, but to the greater illumination when gas is employed. If persons would be satisfied with the same dim light to which they are accustomed when burning candles, or if they would increase the number of the latter so as to equal the light of the gas flame, the heat given out would be found less when burning gas than when burning lamps or candles. It has, indeed, been proved by experiment that the combustion of colza oil produces nearly twice as much heat as the flame of cannel gas of the same standard of luminosity, and that in comparison with ordinary 13 sperm-candle gas the proportionate amounts of heat are as 78 to 68. A room lighted by a large moderator lamp burning colza oil is per-

ceptibly heated quite as much as by a gas flame that gives a larger amount of light.

The conditions which affect the purity of the same air of a room are, however, not all the same in the case of lamps or candles as those which prevail when gas is used. In the case of the lamp or candle, the wick either draws up the hydrocarbon on which it depends for its light by capillary attraction, or else this hydrocarbon is forced up the wick at a uniform rate by an equable pressure. In the case of gas it is usually different. The gas comes from a street main, in which the pressure is constantly varying, partly in consequence of the continual variation which takes place in the number of lights in use. For instance, if a large shop suddenly lights up its establishment, a sudden decrease of pressure would occur in the neighboring houses. In order to obtain sufficient light in a neighboring house, it might be necessary to turn the cock of the burners full on. When the lights in the shop are extinguished, the pressure would be suddenly increased, and the gas would be forced through the burners more rapidly than it could be consumed, consequently, much impurity might be forced into the house in the shape of unconsumed gas. It is therefore necessary to regulate the pressure at which the gas reaches the burners, and many of the complaints of the impurity of the air of a room, caused by gas, arise from this want of regulation of pressure. The pressure can be regulated by the use of a governor placed either at the meter or in proximity to the light itself. From these various considerations it is apparent that the more perfect the combustion is in the artificial light, the less it will affect the purity of the air in a room; but so long as the light is burned in contact with the air of a room, the air will be more or less affected.—*Builder.*

ARCHÆOLOGY.

RECENT ARCHÆOLOGICAL DISCOVERIES IN NEW MEXICO.

J. C. COOPER, TOPEKA, KANSAS.

Traveling in New Mexico a few weeks ago, I had the pleasure of meeting Mr. Amado Chaves, Superintendent of Public Schools for the Territory of New Mexico. He resides at San Mateo, in Valencia County, and I incidentally learned from him that he had made an archæological discovery that appears to me to be a very interesting one.

His home, San Mateo, is situated twenty-five miles north of Grant Station on the Atlantic and Pacific R. R. About a mile from his house there is a large sand-hill, which he has ridden over hundreds of times, and it had not appeared to possess any special interest, until a few weeks before I met him, he was pass-

ing over it, just after a severe wind-storm, and was surprised to see a portion of a stone wall exposed to view. His curiosity was excited and he immediately set to work investigating it, and he has found the wall, on the side where he has been at work, extending two hundred feet, built of stone, laid up with lime mortar, three feet thick and very solid. He has cleared five rooms, one of them twenty-five feet long and twelve feet wide, with the interior corners rounded. The other rooms are small. The large room was evidently used for some special purpose. The building was two stories in height. It appears to be a quadrangular structure with a placita in the centre. In the rooms he found a number of stone hammers and axes, with a depression cut around them to fasten them to a handle with a withe—corn-cobs and the hard, woody stubs of squashes, pottery, turquoise beads and beads of red coral, which must have come from some distant country, also some black ornaments, apparently of ebony set with turquoise, and a perfect skeleton of a woman with fine, light chestnut hair.

He found all the doors walled up from the outside so neatly that only from the inside could he tell where the doors had been.

Mr. Chaves is a pleasant, intelligent gentleman, an enthusiastic educational worker, and well informed in the prehistoric history of that section of our country, and he says that the character of the workmanship of these building is different from any that he knows of or has heard of. The timbers that supported the roof have been burned, but the walls are in a good state of preservation.

In the spring Mr. Chaves designs to try and trace out the whole structure, and he will put roofs on some of the best rooms and utilize them. He thinks this was unquestionably a town inhabited by subjects of Montezuma. When that monarch found himself hard pressed by the Spaniards and their allies, he called all his children together. They being loyal and obedient subjects, at once started for Old Mexico, leaving their houses well closed, hoping to return as soon as they had destroyed the Spaniards,—but fate decreed otherwise and they never returned. Afterwards the Apaches came, took possession of the country and burned the town. In course of time the winds have eddied the dust and sands of the plains about it and buried it completely.

I regret that I had only a few minutes to talk with Mr. Chaves about his wonderful find, but I hope to have an opportunity to visit the locality and get fuller particulars about it.

MASTODON REMAINS IN MISSOURI.

A. M. STALNAKER.

On the 18th of October, 1883, there were found at Springfield, Mo., in digging a well, two pieces of a tusk of a mastodon, the two pieces making about four feet, one of them being the point and the other a section from the middle; but they did not fit together, showing that there was a piece gone from between

them. On the 24th the piece three and a half feet long, now in possession of the Academy of Science at Kansas City, was found together with another piece one and a half feet long. This short piece was from near the point and the large piece appears to be the base of the tusk, as one end is more decayed than the other, evidently showing that this part had been in the mouth and not covered by as perfect an enamel as the other portion. These two pieces did not fit together, and there appeared to be a part missing from between them. The last two pieces lay side by side and but three or four inches apart with the broken ends both pointing the same way. The first two laid in a right line and about a foot apart, and about three feet away from and above those found on the 24th.

The well shows about eight feet of earth and then seven feet of solid rock. Below this rock is a bed six feet in depth of soft mud mixed with gravel. This was once a subterranean stream, the cavity being only six feet wide and walled with solid rock. In clearing out this mud that ran into the well from this cavity the tusks were found, they not being in the well but about three back in the cavity. Just where the tusks were found the rock overhead ended, apparently, showing that at some time the mouth of the spring (which now comes to the surface a hundred yards down the hill) was at this point and had been a watering-place for the huge animals of that remote time.

PROCEEDINGS OF SOCIETIES.

MEMORY.

DR. R. WOOD BROWN.

[*Read before the Kansas City Academy of Science, December 21, 1883.*]

MR. PRESIDENT, LADIES AND GENTLEMEN:—There is no subject of Nature so interesting as psychology. Man, ever since his creation, has been trying to penetrate the mystery, mind, and after thousands of years the subject is just as obscure as it was to the first investigator. The physiologist alone has been rewarded, the psychologist is still striving to wrest from Nature this her most subtle secret.

We shall, this evening, show how memory acts from a physical standpoint, also the theories advanced explanatory of the action of the mind. We may say that memory is an attribute of the mind, but it would be more correct to say that they are synonymous, and that thought and imagination are attributes of memory.

Science has not been able to explain the causation of memory, but her votaries have done much toward explaining physically the action of it. It must be remembered, that while the data are voluminous, and the number of nerve fibres and cells estimated, the conclusions arrived at are in many cases hypothet-

ical as regards the action of memory. The metaphysician has done but little, the physiologist almost everything.

The most succinct definition of memory I find is Ribot's. He says that: "Memory is the retention of certain states, their reproduction and their localization in the past" We certainly cannot wish for a more clear analysis. Physiologists have located the intellect in the gray matter of the brain, a thin crust one-tenth of an inch thick and composed of convolutions and sulci. It has been estimated that there are about 300 square inches of gray matter upon both hemispheres. This crust is supported by white matter which is a mass of nerve fibres, and makes by far the largest part of the brain. The gray matter is composed of cells and fibres, which according to Mr. Bain, number about one billion and five billions respectively. These cells and fibres are the factors of memory, and for distinctiveness at this time I will denominate them memory-cells.

An acquisition is a certain thing acquired or learned, and in a richly endowed and highly retentive mind of, say, two hundred acquisitions, each grouping would require five thousand memory-cells and twenty-five thousand fibres. It must be remembered, that the brain, besides having memory-cells and their associated fibres, is also a sort of battery to furnish power for movements of muscles, acts of energetic volition, and also of feeling.

The causation of memory is just as mysterious as that of life. Memory exists and that is the sum total. Life was brought into existence, either from a fortuitous combination of oxygen, nitrogen, hydrogen and carbon, making protoplasm, which became animated, or by a special divine act of creation. Scientists generally agree that all life must have antecedent life, which to my mind is the only proper solution of biology.

The two most plausible theories which account for memory physically, are the residua and vibratory. According to the former theory, when an impression is received by a cell, a residuum is left, the result of a chemical change or decomposition of its protoplasm. When we look upon a pear, certain cells respond to the excitation of the impressions of contour, color, size, and stem; the result of this responding is a residuum. If these impressions are repeated often enough a permanent residuum is formed and we have a memory-cell. Decomposition is the act of separating the constituents of a compound. These constituents would be elementary bodies, but in the above cells, the decomposition is said to leave a residuum, but no explanation is given, as regards the action of the residuum after it is formed. I am at loss for any logical deduction whereby I can understand the action which goes on in the cell after it has been completely decomposed and a permanent residua has formed, which under this theory I would call a memory-cell. The residua theory leads us to the time when the cell becomes permanently changed, but does not enlighten us upon its subseqent action.

The vibratory theory explains the physiological action of memory in a very satisfactory manner. If we look at the pear, certain cells vibrate from excitation, resultant from the impression. We do not have, in this instance, any decomposition or residuum, simply a vibratory movement. The cell remains

the same, except the molecular arrangement. When the impression ceases, the cells cease to vibrate, and obtain a period of rest which is essential to memory. It will be noticed that the vibration of a cell is clear to the mind, because it acts in its entirety, rest, and vibrates again to the same impression; each vibration fixes permanently its peculiar movement, and we have a cell which vibrates to no other impression, and the result is a memory-cell. This is much better than the residuum theory which leaves a residuum after every cell vibration and eventually a permanent one.

When an impression is received upon the retina, tympanum, tongue, fingers, or olfactory bulbs, it is conveyed by proper nerve filaments to cells in the gray matter of the brain. These cells vibrate from excitation, and undergo a change, say, that of molecular arrangement. If this impression is repeated often enough the molecules are permanently changed and we have memory-cells and remember the impression. If, on the other hand, the impression is made but once, and then not violently, the cells assume their first condition and we forget the impression, it passes from our mind. In this connection let me say that in the true sense, we do not see an object, hear a sound, feel a substance, smell an odor, or taste edibles; we simply become conscious of the impression, when they irritate to vibration the cells in the gray matter. These impressions cause different cells to vibrate the same to the same excitations, which allows differentiation, and memory is the result. If different cells responded to the same impression, there would be no permanency, consequently no cognition.

Why do the same cells vibrate to the same impression? The most plausible explanation is molecular change. If we strike a bar of steel upon the end with a hammer, we can produce a magnet. The blow causes a change of molecules in the steel, and polarizes them. Whether the molecules of a cell are simply changed, or polarized, is hard to determine, but that some change takes place by vibration is evident from the fact that we remember more easily where the impression is received many times.

If the molecular theory is correct, and every substance is composed of molecules, the whole body cells in the gray matter would be no exception Some men of learning say, that the molecules of the body are polarized in health, and when disarranged disease is the result. If this is true, and nervous force electricity, and the brain the battery, why not say that the change in a memory-cell is molecular?

Why does the same cell vibrate to the same impression? Force or motion travels in the direction of the least resistance. When an impression is carried along a nerve fibre, there is a certain amount of resistance, and every impression weakens its power to resist, and each succeeding impression travels along the fibre which is attuned to it and has the least resistance. If the same impression is carried on the same nerve fibre, it must necessarily reach the same cell, which vibrates according to its molecular change and we become conscious of the impression. I would, in this connection, say that repeated impressions are not always necessary to produce a memory-cell. A sudden violent excitation will

cause a permanent change in a cell. We all have experienced sudden impressions which we have never forgotten, and never have felt but once.

To remember is to recur almost instantly without exertion of will, to recollect is to recall by associations, to gather ideas step by step until the impression sought is brought to mind. We recollect by association, by a group of cells vibrating which excites another and so on. According to Bain there are about one billion cells and five billion fibres. These fibres connect cells and consequently groups. It will be readily understood how this occurs, if we bear in mind how we think; how one thought brings another into consciousness. We smell a rose, its odor excites certain cells; through fibre connections other groups are excited to vibration, and we are conscious of events where the rose assumed a prominent part. We see a face which recalls the name and peculiarities of the possessor. We see a house and recollect the persons living therein. The house causes an impression which excites to vibration a group of cells, which in turn brings other groups into activity and we know the occupants. Most of our thought is through association, comparatively little that is instantaneous.

In remembering, time and space are of little value, but they are essential to recollection. When we indulge in retrospection, memory carries us back weeks, months and years. We cannot recollect without time and space. The time is the present, space the period between the occurrence and the present moment.

We have a conscious and organized memory. When we perform an act with a distinct end in view it is the result of conscious memory. When a beginner is learning to play upon a piano, every note is struck by the effort of the will and therefore conscious. In setting our watch, we do it consciously, we have found the correct time and our mind is on the act, and we turn the hands carefully until our aim is accomplished. Therefore every act of will power is the result of conscious memory.

Intensity and duration are indispensable to conscious memory. If one of these conditions be wanting or any other unknown to us, then consciousness (a part of the whole) would disappear, and that which would remain of the fact is organized. Intensity is a degree of concentration which may vary, owing to the striving of our states of consciousness to supplant one another, and victory results either from the superiority of one or weakness of the other. Duration is the period between the impression and consciousness of it. Ribot says it requires 0.16 to 0.14 of a second to hear; 0.21 to 0.18 of a second to touch, and 0.20 to 0.22 of a second to see. This would indicate that the expression, "quick as thought," is a mere figure of speech.

The acts of organized memory are performed unconsciously, involuntarily. The odor of food will sometimes cause an increased flow of saliva. When we were learning to walk our steps were taken with hesitancy and deliberation,—consciously; now we walk without knowing it, our conscious memory through continual repetition, has become organized. If we meet an obstruction on the sidewalk we unconsciously move it to one side to avoid it. This is the result of

experience. We know intuitively that if we do not turn, we will run into the obstruction. Intuition and organized memory are to my mind synonymous. We raise food to our mouth without consciousness, this is the result of habit. Habit is resultant from frequent repetitions which produce organized memory. Upon reflection we will find that comparatively few of our acts are conscious. Consciousness is a narrow wicket through we are connected with the outer world.

I spoke of a group of cells always vibrating to the same impression, and another argument in favor of that statement is the weariness which ensues upon protracted vision, hearing, taste, etc. If different cells responded to the same impression there would be no weariness. Cells do become tired and refuse to act. If we look upon one color continually it becomes blurred, one continual sound becomes indistinct, the odor from a flower is at first acute, afterwards less fragrant. This would indicate two things: first that the same cells respond to the same impressions; second that memory-cells must have rest. This rest is given by exercising different faculties and by sleep. But even in sleep this result is not always attained, for we often dream, and dreaming is cell activity during sleep. This is proven by the fact that we never dream of anything but past events.

Physiologists have proved that during sleep, the brain is pale from want of blood, but if the sleeper dreams it is a brighter red. This would indicate an activity of the brain during dreaming. One of the peculiarities of dreaming is the extreme brief period which is required, also it takes no note of time or space. A drop of water has caused a dreamer to travel thousands of miles, to drown in a lake and to wake him up. A gentleman in this audience once dreamed "that he was walking through a street, and stopped before a hardware store in which were stoves arranged in tiers one above another; while looking at them they fell with a terrific crash to the floor." Another student throwing a box down stairs caused this dream and awakened the dreamer at the same time. Dr. Carpenter relates the case of a clergymen who fell asleep in his pulpit, awaking with the idea that he had slept for more than hour; but on referring to his hymn book, he found that his sleep had lasted through the singing of a single line.

As the hour is getting late I will omit any remarks on imagination, emotion and somnambulism. I wish to thank Col. Case and Mr. Warren Watson for the use of their libraries, also Dr. E. R. Lewis, Dr. J. T. Mitchell, and Mr. E. A. Cwin, for procuring the human brain which I will now demonstrate.

METEOROLOGY.

THE WEATHER SPHYNX.

C. A. SHAW, OF ERIE SIGNAL SERVICE STATION.

[*A Lecture before the Natural History Society of Erie.*]

When the proposition was made to me to give a "chalk talk" upon the weather, I appreciated the compliment implied, but I questioned the possession of the requisite qualifications for the duty. It was desired to have presented to the audience the methods employed by the Signal Service in the formulating of their weather predictions. It was implied that being in the service I should be acquainted with the *modus operandi*. And yet I am not. I merely know, generally, in regard to meteorological data, and the general application of certain principles; but the chief office neither discloses nor, so far as I know, has it any recondite special methods. When they get hold of a capable man with a genius for the profession, a man with a knowledge of celestial mathematics, natural philosophy and cautious common sense, they set him to the task and in two or three years turn out an assistant "prob." But how he separates the essential facts of the weather reports from the non-essentials is never made public and probably is only learned by experience.

I think, myself, that the service is hampered and hampers itself by an unnecessary collocation of foreign materials and duties. Facts of natural history, recondite analyses of principles, of chemistry, of astronomy, of ornithology, etc., interesting in themselves, valuable in the sum of human knowledge, but not of present importance to meteorology. Not to speak of the military accompaniments, there is a terrible loss of time, money and energy and good feeling, in the lack of concentrating the intelligence of the members of the corps upon the few essentials of actual weather prediction and letting everything else go.

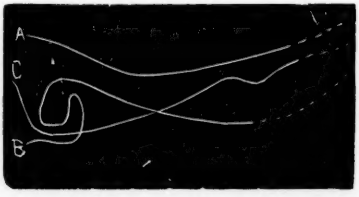
As the sergeant sinks the man of originality in the routine of his rank, he loses that very quality of intellectual alertness that makes him most valuable to the office he is expected to serve. Perhaps I should say there should be no one in the service lower than a commissioned officer, only that implies the knowledge of military duties.

That there is an antagonism between military and scientific duties, I feel so strongly that even the loss of any rank would I think be preferable. I do not think a meteorologist is at all benefitted by knowing that a general outranks a major, or that there is a difference between closing up a regiment and shutting up a book.

"Areas of low barometer" have been so frequently referred to of late years

that it is not required of me to make an extended reference to them, although technical terms in every science deserve to be frequently analyzed that their special application may be borne in mind. In meteorology "an area of low barometer" is merely the space over stations where, in any extended survey of the pressure of the atmosphere, the barometer shows the least height. Stations of like barometric reading being connected a series of rings is usually formed about the space of least pressure and this space as it moves over the country produces an imaginary line (generally imaginary, though in some cases, as a cyclonic disturbance, the track is apparent enough) which line is usually in a direction from the southwest to the northeast (to the Gulf of St. Lawrence) or easterly from Manitoba (with a southerly bend over the lakes) to the same point.

The following diagram, though rude, may serve to illustrate the tracks of low barometer during July, 1883. This month is chosen because of some curious "twists" made over that portion of the country included in Colorado, Nebraska and Kansas, which can only be explained by considering the position of antagonistic areas of high barometers at this time:



From Manitoba to the Gulf of St. Lawrence there were four tracks, nearly similar. The curve marked "A" represents them, as a whole.

From Colorado four others were charted. Three of these (marked "C") passed off the coast near the same point as those from Manitoba. One (marked B) took a southeasterly direction, after going nearly directly north, to Yankton, and left the coast at Norfolk, Va. This turned northeasterly over the ocean, however. The dates were as follows:

From Manitoba: No. 1 on the 1st and 2d; average velocity 39 miles per hour. No. 4, on the 9th and 10th, average velocity 42 miles. No. 5, on the 11th, 12th and 13th; average velocity 24 miles. No. 6, on the 13th and 14th; average velocity 28 miles.

From Colorado: No. 2, on the 2d, average velocity 41 miles; this moved first northeast, then took a backward twist southwest and then went northeast again. No. 3, from the 4th to the 7th; average velocity 30 miles. At first the motion was slow and due east—rate 100 miles a day. Then it raced northeast at nearly a thousand miles per day pace. No. 7, from the 15th to the 17th; average velocity 28 miles. (This is marked C.) No. 8, on the 20th to the 24th; average velocity 18 miles (marked B).

Nearly every one of these latter was deflected and delayed at that portion of

its course which is indicated by the twist in the diagram but it was No. 8 (B) which is especially to be noticed.

This one was near Santa Fe, N. M., on the 20th; it was fifty miles south of Dodge City at midnight, and 300 miles north, between Deadwood and Yankton, the next morning; then it took a retrograde and southerly direction, passing westward, near W. Las Animas. Thence (by a curve to the eastward,) northerly into Dakota again on the 22d; on the 23d directly eastward to Dubuque, and southeasterly on the 24th.

This was not an area of marked depression, which partly explains why its course was so variable. But to really understand the reasons for its wandering we must picture to ourselves an area of high barometer checking and preventing its eastward movement, just as a king, in the familiar game of checkers, drives or embarrasses the movements of a "man" in his attempts to get into the king-row, or the double (dodge) corner.

It is so usual to speak of areas of low barometer and assign to them the cause of associated storms, to speak of their tracks and predict their courses, that it will at first strike the hearer as paradoxical to deny the actual existence of an area of low barometer at all. Yet why should this seem paradoxical? We do not deny the existence of the phenomenon. We merely ascribe it to a more remote and more completely satisfying and logical cause. We speak of cold as a positive condition in familiar enunciation, yet in scientific formulas it is accepted as a purely negative condition, the absence of heat. The magnetic needle was once believed to point to an attracting pole, yet now it is known that it merely exhibits the quality of any balanced piece of steel to take up a position at right angles to currents of electricity flowing about it. The world has these currents moving from west to east. The needle consequently points north and south, and its variation is not the shifting of a pole but the shifting of equatorial lines of magnetic movement.

Suppose I should say that I think that the cause of the easterly direction of areas of low barometer arises from the slow undulation northward of areas of high barometer.

Perhaps many here are familiar with the appearance of the ocean and have studied its motions along our coasts. The ground swell will illustrate my theory of high barometer.

This swell has been not inaptly compared to the slow breathing of a huge marine monster. Sometimes its presence is almost imperceptible to the eye and to those upon its bosom. But one standing upon the shore will see a rock become slowly submerged and then as slowly be made to appear, while the swell, reaching the land will send one long encroaching wave far up the beach. Suppose this swell from the southeast. A practiced eye looking off upon the sea might be able to see that a fleet of vessels would successively betray a trough running toward the northeast. The deflection depends upon the character of the shore, the result no doubt of a partial retardation of the shore end of the swell so that the long waves do not continue parallel to each other.

We know that there is a greater barometric pressure over the parallel of latitude 32°, than at the Equator or at 64°. It is assumed that from latitude 32°, and from the poles, the suction of the atmosphere is towards each other. The meeting place may be at latitude 64°, theoretically, but by reason of terrestrial influences this meeting point may be considerably south of that, in fact may be over a debatable ground between parallels 40° and 60° of North America, but higher over the Atlantic Ocean. This would make the cause of low barometer, and the resultant of the force exercised by two areas of higher barometer. For if a wind, blowing at the rate of twenty miles north meets a wind blowing at the rate of twenty miles west, there will be produced either a wind which shall be in proportional direction and velocity to the two causing it, or else it will produce a system of vortices in the direction resultant of the two, but of no fixed velocity, especially if these winds are believed to decrease in power as the distance from the originating area increases.

In dealing with such an elastic medium as the air and with the imperfect data at our command it is impossible to say how the no doubt daily reinforcement of wind pressure from the originating lands should provoke a disturbing area about once in three days along their meeting line.

If instead of actual motion from latitude 32° and from the poles we think of two undulations (deflected by the rotary motion of the earth, the one to the east the other to the west), I think we have a basis upon which a theory of the cause of low barometer may be formed capable of arithmetical calculation as to force and direction. I do not wish to seem to explain too much in one argument nor yet to suggest too recondite a system of weather predictions, but upon some such grounds as these must, I think, the future meteorolgist stand who will pretend to be able to foretell, more than a few hours in advance, changes and conditions.

Whether atmospheric pressures can ever be formulated into such mathematical precision that weather conditions can be predicted as certainly as astronomical changes I am inclined to doubt. I fear meteorology will always remain an empiric rather than an abstract science. With the accumulation of facts general principles are formulated, but they more and more take the form of contingencies. As in our judgment of men we trust more to experience and comparison than to an ideal scale of possibilities, so, in weather knowledge, short views and cautious application of general laws are more frequently correct than more pretentious forecasts. It is only with casual phenomena that practical meteorologists care to deal, and of these temperature is the one of most popular interest. This subject is next in order to be considered.

TEMPERATURE.—It may be hardly necessary to say that outside of the Signal Office at Washington, with its tables and charts at hand, and its corps of trained assistants, no one can expect to make a weather prediction which shall be more than probably correct, and that for only a brief period in advance. Even without the special training and facilities of the central office there is a tendency to

rely too exclusively on merely local appearances, which, at best, may prove deceptive.

Perhaps of weather predictions that in regard to temperature is the safest, or at least most frequently desirable in a remote locality.

Still, even for this there must be weather bulletins, and it is almost as necessary to see such bulletins, either in a daily paper or in a convenient place to study them, as it is to have eye-sight to get any ideas from a book.

Weather charts are undoubtedly the best form in which these reports can be presented. Several skeleton charts have been invented. One by Mr. Isaac P. Noyes, of Washington. But he can get no newspaper proprietor to take hold of it and make it *go;* and though I tell him to advertise it and make its value apparent to the public, as a "long felt want," he has not yet made it available to the world.

The bulletins issued by the Government at stations have the disadvantage that few care to stand up in a public place and study, for any length of time, the somewhat confused programme there presented to view. A studious man wants things comfortable—an easy chair, a quiet library, security from interruption and especially an arrangement of stations geographically adjacent.

Taking such a bulletin, or one as near it as a person can get hold of, if he wishes to find whether it will be warmer or colder during the next twenty-four hours, he regards attentively the point from which the wind is blowing at his own station, and following this direction, backward, notes how far the same wind-direction continues and, incidentally, the wind-velocity, and the difference in barometric pressure. In nine times out of ten the wind will bring the temperature of the place from which, in a certain number of hours, the wind is blowing, at its reported velocity. But there is one exception. The temperature falls as we rise above the earth's surface at about the rate of one degree to every 300 feet, or 20° to a mile. Warm air rises and cold air rushes in to fill the space left, and when air from a higher elevation comes to the surface of the earth it brings that lower temperature with it. Such change usually occurs after an area of low barometer passes. The cold northwest wind that generally follows does not, necessarily, come from a long distance. It may come from overhead. Guarding agalnst this contingency, we will say:

The laws governing temperature act more uniformly and are more easily applied than those relating to barometric changes. They may be formulated as follows:

The temperature of a place, at any time, depends upon the actual amount of heat received from the sun, influenced by the prevalence of a warm wind (generally) from the south or a cold wind (generally) from the north, or a situation protected from either of these influences.

The first cause—actual heat received—is the effect mainly of latitude; the second is the result of areas of low barometer, producing if the track is north of a station, wind from the south; and wind from the north if the track is south of the station.

As the atmosphere is a very poor conductor of heat the change at any station is solely the result of bodily movement of air from one place to another. Thus, if the temperature of a place 400 miles northwest of us is twenty degrees lower than it is here and the wind is twenty miles an hour from the northwest, it will take twenty hours for the temperature to fall those twenty degrees; and supposing the wind to blow only ten hours at the rate mentioned, the temperature will fall only to that point which a station half of the distance northwest had at the time it started.

This, stripped of all interfering circumstances, is the philosophy of areas of heat and cold. These interfering circumstances are, however, so numerous as to make the application of any abstract rule impossible, without many reservations.

It is not always true that a southerly wind is warmer than a northerly one. Very much depends upon the country over which the wind has passed. There may be fields of snow to the south and none to the north. There may be open bodies of water, forests, or even the modifying influence of large cities. Then, too, the wind we get from the south may not have come from a point very far south, but only deflected from a northerly direction. "The cold end of a south wind" is a proverb familiar to all.

But without entering into too many qualifying details, we may for the present take the following table of actinometry as approximately representing the difference in temperature for every ten degrees from the equator to the pole in the northern hemisphere; it shows the actual temperature due to the reception of heat from the sun:

Latitude	0	10	20	30	40	50	60	70	80	90
Summer	58	59	60	63	66	67	68	66	64	62
Winter	38	36	32	28	24	22	18	14	5	0
Mean	48	48	46	46	45	44	43	40	35	31

Taking latitude 40 (nearly that of Erie) we will have, in winter, a lower temperature of about 1° for every 200 miles we travel north and an increase of about 1° for every 200 miles we travel south. If, therefore, the temperature falls very low in the northwest at a place that is on a parallel 600 or 800 miles north, we do not expect as low a temperature here, but one which shall be from 5° to 10° higher, as belonging to a lower latitude. And this again is modified by local conditions and the actual starting point of the wind which brings with it the temperature experienced. The wind would have to blow all day at forty miles an hour to bring us the actual low temperature of stations a thousand miles northwest of us. Usually forty-eight hours at half that velocity is an exceptional occurrence.

Similarly, if it should blow from the sonth with like continuance, we should have tropical weather as a result.

So much depends upon the mean direction of the wind that the usual tracks of low barometer can never be omitted from our calculations. At Erie about

half pass to the north and half to the south, so that the mean direction is about equally divided. Places considerably south of us have the wind so generally from the south that their temperature is far above the average produced by actual heat receiving conditions, while in British America, to the north, the opposite effects are produced. These tracks are lower over America than over the Atlantic Ocean, where they go very far to the north, either from Gulf stream influences or other causes, and a higher temperature prevails on the same parallel, than over this continent.

The line of mean temperature is also affected by local causes so as to form a very irregular curve. Take the May mean, for example, which at Erie for 1883 was 54°. This passed through Portland, Maine, and west of us, Cleveland, Toledo, south of Chicago, Dubuque, Yankton, and then in a southwesterly curve to Santa Fe, a point nearly 5° south.

The isotherm of June included Burlington, Vermont, Oswego, Erie, Port Huron, Chicago, St. Paul, Huron, Dakota, Bismarck, and Fort Buford. It was colder both north and south of Dakota than in Dakota itself, during that month.

In July the mean temperature was the same at Newport, Rhode Island, Portland, Maine, Albany, Erie, Detroit, Chicago, LaCrosse, St. Paul, Huron, Dakota, Fort Bennet, and down to Denver.

It may well seem almost impossible to average such variable lines, and yet, taking these for a number of years, there is seen to be a tendency to a slight northerly curve west of Erie, and then, beyond Chicago, a northwest direction in summer and a southwest direction in winter.

In other words we have during the summer temperature similar to Dakota and in winter that of Colorado.

Taking the charts of the mean temperature lines for any month we have a partial guide for determining what temperature we will ourselves experience; for, generally, the temperature that is reported west of us, upon the line appropriate to the special month considered, reaches us in due time, (three or four days) with a fair degree of regularity, through all seasons,—interrupted, of course, by those areas which override these general rules and come with actual wind velocities from exceptional distances.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The first ten days of January gave the coldest weather of the season to this date. The very low temperature of −22.5° was recorded on the morning of the 5th, and the effects of this were greater owing to the low temperature which prevailed through the last eight days of the previous month.

Robins have been seen here in the latter part of December and during the first decade of January in spite of the cold weather.

The red glow at sunset and sunrise still continues, though less noticeable, perhaps, than in December.

The comet during the past ten days has been distinctly visible to the naked eye, and its position is 30° above the horizon at 8 P. M. in the W. SW.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Dec. 20th to 30th.	Jan. 1st to 10th.	Jan. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	15°	−22.5°	−4.0	. .
Max	42.0	38.0	53.0	. .
Min. and Max	28.5	30.3°	28.5	. .
Range	27°	60.5°	57.0	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	21 0	—.55	17.0	14.15
2 p. m.	34.5	12.4	37.4	28.1
9 p. m.	25.0	3.4	24.3	17.6
Mean	26.6	5.08	26.23	19.97
RELATIVE HUMIDITY.				
7 a. m.	.98	.89	.83	.90
2 p. m.	.93	.80	.80	.84
9 p. m.	.94	.82	.82	.85
Mean	.95	.84	.81	.86
PRESSURE AS OBSERVED.				
7 a. m.	28.912	29.251	29.210	29.124
2 p. m.	28.942	29.231	29.190	29.121
9 p. m.	29.130	29.272	29.225	29.209
Mean	28.961	29 255	29.208	29.151
MILES PER HOUR OF WIND.				
7 a. m.	10.7	11.0	9.3	10.3
2 p. m.	11.2	18.2	24.5	17.9
9 p. m.	10.9	11.6	14.8	12.4
Total miles.	2777	3272	3896	9945
CLOUDING BY TENTHS.				
7 a. m.	6.0	8.0	5.0	6.3
2 p. m.	7.1	6.2	3.8	5.7
9 p. m.	4.9	4.0	2.7	5.8
RAIN.				
Inches.	0.25	0.15	0.25	0.65

A NEW THEORY OF DEW.

PROF. B. F. NIHART, A. M.

Investigations which Prof. Stockbridge has made at the Amherst Agricultural College, upon the comparative temperatures of the soil and air, and the deposition of dew upon the earth and plants, have led him to conclusions very different from those commonly received in regard to the formation of dew. It is usually held that dew is the moisture of the air, condensed through contact with objects of a lower temperature, and that it does not form till radiation has reduced the temperature of the earth and other objects below that of the atmosphere. The experiments referred to seem to indicate that as regards objects in the immediate vicinity of the earth at least, the process is the converse of this; viz.,

that the dew is the result of condensation by the air of warm vapor as it rises from the soil. The course of experiments from which this novel scentific theory was deduced is as follows:

The basis of the theory is the discovery that in summer the average temperature of the earth at night is greater than that of the atmosphere. The temperature of the earth in an inclosed space on a level with the surrounding soil, and the temperature of the air were taken at the warmest time of day and the coldest time of night for several months, and the average temperature of the air for the season was found to be 72.94°, and that of the soil 72.061°; but the average temperature of the air at night was 49.664°, and that of the soil 56.37°, the earth thus averaging at night over 6° warmer than the atmosphere. The temperature of the soil and air at night was also taken at various points within ten miles of the college, on all kinds of grass land and bare soil, and in the forest, and the same facts were obtained, the soil being at all times warmer at night than the air.

These results led to experiments on dew-fall. Two boxes, each of a cubic foot capacity were filled with soil without disarranging its strata, one receiving absorbent, retentive loam, and the other peat. These boxes were placed in a trench in an open field level with the surrounding ground and exposed to the weather. Through the month of June they were weighed night and morning, and, unless there was a rain in the night, they uniformly weighed less in the morning than at night, the loss being from one to three ounces for the loam and one to four ounces for the peat. This Prof. Stockbridge thought indicated that the soil at night gave forth water, and that the moisture found on the surface of a field in the morning came from a deeper soil rather than from the air. Other similar experiments followed. In one a cabbage plant was enclosed in an air-tight tin case. Where the stem of the plant protruded through the top of the case, wax was used to make it impossible for moisture to escape through the leaves. The can was first kept within doors and weighed night and morning, when it always showed a loss during the night of from 1.21 grams to 1.78 grams. When left out of doors at night, with the can wrapped in cloths to prevent moisture reaching it, the loss was from .55 grams to 4.23 grams, showing a loss even when there was moisture or dew on the leaves.

These experiments, continued through the season, gave Prof. Stockbridge these proofs of his proposition, that the dew on the ground in the summer is the condensation of vapor that rises from the earth. 1. The vapor of the soil is much warmer at night than the air, and would be condensed by it. 2. Vapor from the soil is soon diffused and equalized in the whole atmosphere, but in largest proportion when evaporation is taking place near the surface of the soil; and, other things being equal, plants nearest the earth have the most dew. 3. Dew under haycocks, boards and like objects on the ground could receive it from no other source.—*Industrialist.*

ENGINEERING AND MINING.

STREET PAVEMENTS.

WM. B. KNIGHT, CITY ENGINEER.

In the interesting article on the subject of "street pavements," which appeared in the January number of the REVIEW, I notice some criticisms on the method of putting down wooden pavements in this city which, I think convey, despite of a limitation noted, the impression that a very important detail of the construction is not sufficiently provided for, or carried out—namely, the complete filling of the interstices between the blocks so as to prevent the surface water from reaching the bottom of the blocks. I wish, therefore, to state that I always fully appreciated the importance of keeping the surface water on the surface, as a matter which adds largely to the life of the wood.

The specifications for all this work, which I drew nearly two years ago, provide in explicit terms for all the interstices between the blocks to be first filled with gravel of approved quality, to be screened and entirely free from sand, and of such size as to fall freely into the holes, being not less than one-quarter nor more than three-quarters of an inch in diameter. The gravel to be well rammed in with proper tools until the spaces are compactly filled to the surface.

This, in practice, requires twice sweeping the gravel over the blocks, and is followed by a ramming after each loose filling.

Asphalt paving cement is then poured (*hot*) into the spaces and joints until they are full, and the asphalt flushes to and runs over the surface. In practice the average quantity of asphalt used is about one and one-half gallons to the square yard of pavement, sometimes requiring much more, depending mainly upon the closeness with which the blocks are laid; on the average size of gravel used, and on the degree of compactness attained in ramming it.

As to the execution of these provisions of the specifications, the system of inspection, and the quantity of asphalt actually used per square yard (only a very small proportion of which remains on the surface) indicate a substantial compliance.

From practical tests, afforded when street pavement has been taken up for various purposes, I have, as a rule, found that the asphalt had penetrated to the bottom of the blocks, and completely filled all the voids between them—forming in fact, as intended, a bituminous concrete in the interstices, and binding the blocks together.

The surface of the blocks as laid, slope each way from the center of the roadway to the gutters on each side, and are maintained smoothly and uniformly in this position by the concrete foundation on which they rest, so that the water

flows quickly off the surface and down the gutters to sewer inlets. There is, consequently, much less liability of the water working into the interstices than is the case in a wooden pavement as commonly laid on boards, or imperfect foundations. This ordinarily wears in flat places and depressions which retain the surface water and produce not only more rapid decay of the wood but aid in its general destruction, besides being very objectionable from a sanitary point of view.

Under all the circumstances I question the advisability of spending more money between the blocks. I think that the principal improvement of the present methods and materials is in the line of improved wearing surface. The round, white cedar block combines more good qualities for the money than any wood at present available. I should prefer, generally, a rectangular-shaped block. This is not obtainable in white cedar, and would be about fifty per cent more costly if of any other suitable wood, according to the best of my present information.

It is not improbable that we may get an oak or a pine from the new Memphis R. R. that will be suitable in quality, and can be delivered sawn up into blocks at a cost which would make it advisable to use it.

The cedar block is now being tested here under entirely new, and more favorable conditions than it has ever been before, and the experience of other cities afford, to my judgment, but very little information as to its durability as laid here. It is mainly from the actual results to be obtained here, in the practical test of wear and time, that a really satisfactory answer can be obtained to the question of how far is it advisable to go in the matter of first cost for a wooden wearing surface for street pavements in this city.

On the general subject I will only now say that in considering the questions involved, and endeavoring to reconcile and understand the accumulated experience of all cities in this matter, it is, in my opinion, primarily essential, in order to arrive at a correct conclusion, to divide the pavement into two parts—the foundation and the wearing surface. This division simplifies the subject in a natural way; affords an easy explanation of many apparent inconsistencies, and aids very materially in extracting the grain of instruction contained in all failures and successes with street pavements.

THE STREET PAVING QUESTION.

COL. R. T. VAN HORN.

WASHINGTON, Jan. 4.—I am in receipt of the Kansas City REVIEW for January, and find in it two very important papers—one by Engineer Chanute on the sewerage question as applied to our city, and the other by the editor, Col. Case, on pavements, which ought to be read by every tax-payer. My own views upon these questions are well known to some of our people, and it is not my

purpose here to urge them, or even endorse what is said in these papers on either subject. It is for a different purpose.

I want to say to our people that there is no city in this country, nor do I think there is one in any other, where the problem of paving can be so advantageously studied as in Washington. And the reasons lie upon the surface. In almost all cities the situation is alike—the kind of pavement and its quality is, from the form of city government, more or less dependent on the wants of contractors—here it is not the case. Where the city council has any control their election generally governs their votes, and contractors elect or defeat in many cases as they choose. In this city the engineer is detailed from the engineer corps of the army and is perfectly independent. The executive authority is a commission appointed by the President and confirmed by the Senate, and is independent of ward politics and contractors. Congress appropriates part of the money and exercises supervision through the district committee—the Government paying for its frontage the same as private individuals.

It will thus be seen that the highest skill is available; discretion is lodged in a perfectly independent executive, and the dangers of corruption reduced to almost absolute immunity. To do bad work or defraud the taxpayer requires both a dishonest engineer and board of commissioners.

The result of all these guards is that Washington is the best paved city in the world. Then, again, men who have patents are anxious to have a sample laid in this city and it has been the practice to afford opportunity for all valuable improvements to be so laid. You can thus find all sorts of wood pavements tested here; all kinds of stone pavements; all varieties of concretes; all patents of asphalt, both sheet and block,—in fact there is hardly a known variety of paving material or method of laying that has not been tested and results attainable. And under the admirable engineering system, the city is under the eye constantly of the highest skill, and is also seen by the leading engineers of the world, who are visitors to the capital. In this way the very best workmanship and the most thorough methods have been employed, and when you find a piece of pavement it is always the best of its class, whatever may be the material used.

Now what ought the people of a city like Kansas City, just entering upon a system of street improvement that is to cost a great deal of money, to do? It seems to me that they should investigate the matter for themselves. Not to see whether the stone men or the wood men shall lay their pavements, but to study the whole question, and determine what is the best for Main Street, what will answer for Walnut, what will best supply the needs of Twelfth, and so on.

If an engineer like Mr. Chanute, able and conscientious, with two or three practical men of high character, were to come here and spend a week or two making a personal examination of the streets of Washington, and consulting with the engineer department and the District commissioners as to cost, methods of construction, durability and desirability of the various kinds of pavements in use here, they would be able to give our people practical advice, that would ensure first-class streets at the lowest possible cost.

I do not know anything of immediate importance to Kansas City that would pay so large a return to her people at the little expense this would be.—*Cor. Kansas City Journal.*

SEWERAGE SYSTEM OF MEMPHIS.

Since the adoption of the Waring system of sewerage, the City of Memphis is one of the best drained cities in the United States. From the reports and exhibits of Maj. Niles Meriwether, engineer in charge of sewers, we gather the following interesting information:

The city occupies the summits and slopes on both sides of a valley, which is drained by a stream known as Bayou Gayoso. The main sewers are located on each side of the bayou, and as near to it as found practicable. There are altogether about thirty-eight and six-tenths miles of sewers, of which four miles are mains, located along the bayou, and discharging into the river by one outlet; the remainder are laterals, draining into these mains, except about four and one-tenth miles of sewers constructed before the present system was adopted, and discharging into the Mississippi by other outlets. The mains are ten, twelve, fifteen and twenty inches in diameter. Of the laterals, about 85 per cent are six inches in diameter, and the remainder eight inches, except a few short lengths, which are ten inches. The mains, for the most part, are laid with a grade of two inches in 100 feet, which is the minimum. The minimum grade of the six-inch laterals is six inches in 100 feet. At the upper end of each lateral is located one of Rogers-Fields' automatic flush tanks, which discharges one hundred and twelve gallons in about forty seconds. This tank discharges its contents as often as it filled, but it is considered that once in twenty-four hours is sufficient. The system is with manholes freely distributed on the mains. No surface or roof-water is permitted to enter the sewers, the system being designed and proportioned for house sewerage only. The house drains are all four inches in diameter, and no trap is permitted on the main drain, each fixture being provided with a separate trap. The soil pipes are of cast-iron with lead joints above the ground, and extend four inches in diameter above the roof. Each house drain is consequently a ventilator for the public sewer. For the purpose of removing the subsoil water, agricultural drain tiles are laid in the trench with each lateral on the grade of the sewer, or below it, which discharge, not into the sewers, but into the bayou. Additional lines of tile have been laid in the streets in which no sewer is located. A large portion of the trenching was done by contract, but the pipes were laid by hired labor. The prices paid for excavating and brick filling were:

Trenches 6½ feet deep, 25c; 6½ to 9 feet, 30c; 9 to 12 feet, 45c; 12 to 15 feet, 75c, per lineal foot. The pipe laying, including laying drain tile in the same trench, also the cost of the cement, sand, oakum and tile paper is estimated at seven and six-tenths cents per foot. The flush tanks cost, completed, about $45 each, including $10 royalty. The six inch pipes, although draining houses

on both sides in some cases, for a distance of 3,000 feet, have never been overcharged, and have seldom been found running half full. No trouble has been caused by sewer gas, and the sewers are believed to be comparatively free from it. Some of the six inch pipes have occasionally been obstructed by sticks, bones, etc., becoming fixed across the diameter of the pipe, all of which have been promptly removed. Twenty-one cases of such obstruction have occurred, which have been removed at an average cost of $13.50 each.

Some deposits have been found in the mains, which have been rapidly and inexpensively removed by the passage of hollow metal balls through them. These balls are less in diameter than the sewers, and being lighter than water are pressed against the top of the sewer, and are rolled along by the force of the current. The velocity of the ball is less than that of the water, which in passing it is deflected against the bottom and sides of the sewer so as to thoroughly cleanse it. A portion of the mains have been cleansed four times since their construction; the laterals not at all. Pipe laying was commenced about the 20th of January, 1880, and on July 1st, of the same year, about twenty miles had been laid. The first house connections were made about the 1st of March of the same year. On the 13th of June, 1882, hourly observations showed the greatest depth of flow fourteen inches, at 11 A. M.; least depth, ten and one-fourth inches, at 4 A. M. Floats in the same sewer gave a surface velocity of two and six-tenths feet per second, the depth being twelve and one-fourth inches.

The following is a statement of the connections made with this system, but does not include those made with the old sewers, discharging by other outlets:

Water closets	4,715
Sinks	3,224
Urinals	179
Bath tubs	334
Wash basins	308
Privy sinks	34
Cellar drains	24

This system of sewers gives entire satisfaction both to the city government and citizens gencrally.

Dr. Thornton, President of the Board of Health, in his last report, has the following to say of the workings of the sewerage system described above:

"The practical working of the sewer is giving entire satisfaction, and, as far as I know, fully answering the ends claimed for it by its projector. The chief advantages of this system over the ordinary sewers of other cities are the economy in first cost, the prevention of sewer gas to its minimum, the exclusion of storm or surface water, and their facility in cleansing themselves, or in the prevention of the deposit of sewage matter in any portion of the pipe. The periodical flushing by an automatic arrangement of a flush-tank, placed at the head of each lateral six-inch pipe, when it discharges, cleanses the pipe of all deposit, should there be any, thereby preventing any decomposition in the sewer."—*Journal.*

THE ARLBERG TUNNEL

The boring of the tunnel through the Arlberg (the Eagle's Mount), a branch of the Rhætian Alps, has been completed.

The Arlberg Tunnel ranks only after the Mont Cenis and Mount St. Gothard tunnels among great modern engineering works of its class in Europe. The object of the new line is to shorten the distance between Western Austria and Eastern Switzerland, create a direct traffic between the two countries, and render them independent of the South German railways over which it has been heretofore conducted. The new line is divided into two sections—the first running from Innsbruck to Landeck, the second from Landeck to Bludenz. The former, which is forty-five miles in length, passes along the right bank of the Inn. Its construction presents no extraordinary engineering difficulties. The construction of the stretch between Landeck and Bludenz has been much more difficult and costly. It is a mountain line from first to last. In the Valley of Rosanna the gradient is one in forty. The road crosses the Valley of Panznau on a viaduct of three arches, each having a span of 197 feet. The length of this stretch is thirty-five miles, and the total estimated cost 11,784,000 florins, or $5,892,000.

At St. Antoine, 1,721 feet above Landeck, is the beginning of the great tunnel on which work has just been completed. The point fixed upon by the Austrian Government for commencing this work is not the one that was chosen by Gen. Nordling, who first surveyed the ground. The tunnel, had his scheme been adopted, would have been higher up the mountain, shorter, wide enough only for single rails, and, therefore, less expensive than the one finally fixed upon. But the Government, believing that the Arlberg Line will some day be one of the most important in Europe, decided that it was expedient to provide every facility for a great traffic. The gradients were made as easy as possible, even though the tunnel should be a little longer, and the line will be double-railed throughout its length.

The work of boring the tunnel began on the Austrian side in June, 1880, and in September operations were begun on the Swiss side of the mountain. The work proceeded at a speed which affords a striking illustration of the improvements that have lately been effected in the art of mountain tunneling. The Mont Cenis Tunnel was bored at the rate of 3,537 feet a year, the St. Gothard at the rate of 5,474 feet, and the Arlberg was pierced at the rate of 7,080 feet a year. The Arlberg engineers also profited by the experiences of their predecessors in the matter of cost, for while the outlay on the Mont Cenis Tunnel was $2,000 per running meter—thirty-nine and one-half inches,—and on the St. Gothard $1,250, the expense of making the Arlberg did not exceed $750 to the meter. In this regard, however, the tunnel last named benefited by its shortness, since the longer the tunnel, other things being equal, the greater is its relative cost.

An interesting experiment was made in the Arlberg Tunnel with a new sort

of perforator. The perforators used in the Mont Cenis and St. Gothard tunnels consisted of a series of chisels (not diamond pointed, as has sometimes been stated), driven with a quick, hammer-like action by compressed air, the machines for the production of which were actuated by turbines at the two ends of the galleries. This system was the one in use on the eastern, or Austrian, side of the Arlberg. The chisels cover a space of seven square meters, and make twenty to twenty-five holes at one time, each from one and a half to two meters deep. These are then filled with dynamite and the mine exploded. Every blast lengthens the drift by about one and a quarter meters. The perforators move forward on wheels, and the air, compressed to a pressure of five atmospheres, is supplied through flexible tubes. On the west side drills are employed of a diameter of seventy millimeters, to which, by means of a water pressure of from sixty to one hundred atmospheres, a rotary movment is communicated. Six or eight of these drills are as effective as twenty or twenty-five of the atmospheric perforators, and the holes they make are so much wider that equal results are produced with lighter charges of dynamite.

The greatest difficulty in Alpine tunneling consists less in quarrying out a passage than in getting rid of rubbish. After every blast the outcome of it, in the shape of loose material, must be removed before boring operations can be resumed; and when an atmosphere already close and impure is still further fouled by the smoke of an explosion, the labor of removal becomes dangerous as well as difficult. Fatal accidents sometimes happen. The leading miners in the Arlberg Tunnel, when engaged in this work, cover their mouths and nostrils with sponges which have been steeped in vinegar, an expedient which has been found singularly efficacious in neutralizing the bad effects of the poisonous air they are often compelled to breathe. The important part which the removal of rubbish plays in these undertakings is shown in the fact that of the time required for the making of the Arlberg Tunnel fully one-half was devoted to the carrying away of loose material.—*N. Y. Herald.*

MINING IN COLORADO IN 1883.

Following is a summary of the coal output of Colorado for the year 1883:

	Tons.		Tons.
Mines near Erie and Canfield	80,000	Mines near El Moro	277,341
Mines at Louisville	103,321	Mines near Durango	12,000
Mines at Langford	45,500	Mines at Rico	2,500
Mines near Golden	19,899	Mines at Crested Butte	75,983
Mines at Franceville	53,757	Mines at Castleton	14,846
Mines at Sedalia	1,500	Other mines	3,500
Mines at Como	58,391		
Mines near Cañon City	272,103	Total product of Colorado	1,114,040
Mines near Trinidad	93,339		

The value of the product, 1,114,040 tons, at $2.25 per ton, is $2,506,590.

COLORADO COAL AND IRON COMPANY.—During the year 1883, this company mined the following amount of iron ore from its various mines:

	Tons.
South Arkansas Mine	19,646
Hot Springs Mine	25,938
Placer Mine	1,512
Total	47,106

This ore was treated at the Company's works at Bessemer, and converted into the following manufactured products:

Merchant bar-iron and mine rail	4,647	tons of	2,000
Pig-iron	25,706	"	2,000
Casting	1,378	"	2,000
Steel rails	16,246	"	2,240
Muck-bar	3,184	"	2,240
Nails	66,724	kegs of	100
Spikes	9,841	"	100

The mining product of this State for the year 1883—gold, silver, copper, and lead—is estimated by the Denver *Republican* as follows:

County.	Amount.	County.	Amount.
Boulder	$400,000	La Plata	128,688
Chaffee	300,000	Ouray	700,600
Custer	800,721	Park	400,000
Clear Creek	2,000,000	Pitkin	125,000
Dolores	200,000	Rio Grande	182,000
Eagle	930,000	Routt	75,000
Fremont	20,000	Saguache	100,000
Gilpin	2,208,988	San Miguel	225,000
Grand	10,000	San Juan	418,954
Gunnison	650,000	Summit	350,000
Hinsdale	390,000	Total	$26,306,131
Lake	15,691,200		

Total production last year, $25,750,898, showing an increase this year of $555,233.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

APPARATUS FOR USE IN TUNNELING, MINING, AND EXCAVATING OPERATIONS.—In the construction of tunnels the usual course has been heretofore to first place in position the drilling mechanism, and prepare holes for the reception

of an explosive; next to remove this apparatus so as to leave the tunnel unobstructed; next to charge and fire the blast; then to load the excavated material upon cars that are run in for the purpose, and after loading, by hand run them out and dump, after which the drilling apparatus is taken back into the tunnel and the whole operation repeated. By this method of operation a large portion of the time has been required for the removal of the excavated material, and but a fraction of the time has been available for such work as required skilled labor, and the construction of a tunnel having any considerable length, has from such cause required so much time as to prevent many similar enterprises from being carried out. To obviate these objections is the design of the apparatus now in hand, which consists, principally, in a car having an open front end and adapted to receive the material as dislodged by the blast and provided with a movable top and sides which may be arranged with a chain and bar combination, to practically close the tunnel and cause the flying debris to fall into the said car. There can also be an adjustable drop apron attached to the extreme front end of the car bottom to prevent any of the material from being blown under the car. The platform, or body of the car, is supported upon four or more wheels, that preferably are of much less diameter than those usually employed, bringing the car as near the rails as possible. Secured to, and extending upward from one end of the body, is an end piece, which has substantially the intended height of the box, while from each side edge of the said body a side piece extends upward to about one half the height of the end piece, and has, hinged to its upper edge a similar piece, that, when placed vertically, carries the height of each side up to that of the end piece. Hinged at one end to or upon the upper edge of the end piece, is a top or cover which has such dimensions as to enable it to close the entire upper side of the car-box when the hinged side pieces are turned inward to a vertical position. This cover is adapted to be raised upward to reach the roof of the tunnel and is thus raised when desired by the following described means, viz: Hinged at one end to or upon the rear end of the cover, is a bar, that at its outer end is provided with a pulley around which passes a rope that has one end connected to a windlass journaled upon the rear end of the car, and the other to the upper side at or near the front end of the cover. The said bar when not in use is turned rearward and downward, where it rests entirely out of the way, but when it is desired to raise the cover the bar is turned upward and forward until it reaches a vertical position, and when its further movement in such direction is arrested and by the turning of the windlass, the rope drawing over the pulley will cause the front end of the cover to be elevated. The upper face of the body, the inner faces of the end pieces, the sides, and the lower face of the cover, are heavily plated with metal, preferably with "T" rails in order that they may be able to withstand the impact of flying rock, and in order that the points between the side pieces may be protected from injury, and at the same time be made sufficiently close to prevent the passage of stones, the continuous edges are bevelled outward and their hinges are placed upon a line with the inner faces of the said parts. The box thus con-

structed is intended to occupy about one-half the vertical dimensions of a tunnel, and to have such width as to enable it to pass freely through the same.

After the drilling mechanism has prepared holes for the explosives it is moved rearward a short distance, and by suitable means is raised to, and held in position near the roof of the tunnel, after which the car is moved inward upon the rails until its front end is near the rock to be blasted, the cover is now raised until its front end is in contact with the upper side of the tunnel, the hinged portions of the sides are turned outward until they rest against the contiguous sides, after which the charge of explosives, which have been meanwhile placed in position, are fired. The debris dislodged by the explosion will fall directly into the car, or will be thrown against the sides or cover of the same and then fall to the bottom, but little if any will fall below or outside of the car, so that the labor of loading the material will be entirely avoided, and the car with its contents may be speedily, run out of the tunnel and dumped; in the meantime the drilling mechanism has been placed in postion. In order to avoid all possibility of the passage of stone, etc., at the sides of the car, a wing is hinged to the front end of each stationary side piece, and is adapted to swing outward against the sides of the tunnel, and not only operates to close the space between the latter and the side pieces, but also acts as a shield for the front ends of the side pieces.

The mechanism described not only lessens materially the time and labor required for the construction of tunnels, mining operations, etc., thereby rendering more speedily available the capital invested, but it also affords protection to those engaged in the work, preventing in a great degree the loss of life which has heretofore attended the prosecution of such work.

Mr. W. R. Kirk, of this city, has evolved the above described labor-saving apparatus.

BOOK NOTICES.

LECTURES ON PAINTING: By Edward Armitage, R. A. Octavo, pp. 337. G. P. Putnam's Sons, New York, 1883. For sale by M. H. Dickinson, $1.75.

These lectures are selected from the series delivered by the author to the students of the Royal Academy between the years 1876 and 1882. They cover the following comprehensive and suggestive range: Ancient costumes, Byzantine and Romanesque art, the painters of the eighteenth century, "David" and his school, the modern schools of Europe, drawing, color, decorative painting, finish, the choice of a subject, the composition of decorative and historical pictures and composition of incident pictures: twelve in all, and evidently intended not only for artists and art students, but also for persons who may desire to ob-

tain some idea of a subject which is rarely treated in a simple and practical manner by its professed teachers.

In reading these lectures it becomes more and more apparent to the reader that the author has constantly borne in mind the duties of the teacher of art as stated in the preface to the work, viz: the general pilotage of the schools through the quicksands and mud-banks with which the deep water channel leading to excellence is beset on every side, and secondly the alimentation of that subtle flame without which the architect degenerates into a builder, the sculptor into a statuary, and the painter into a handi-craftsman.

Every lecture is practical, emphatic and pointed, as well as entertaining; full of instruction to the ordinary reader as well as to the art student; bristling with historical allusions, incidents appertaining to art in all lands and among all well known painters, as well as pertinent suggestions as to color, style, choice of subject, manner of handling, etc. Without an atom of art talent in his composisition the reader will become interested in this book, and long to apply the lecturer's common sense, practical rules and directions in person: the real art lover will unquestionably find mines of information and suggestions well worth working.

THE ORGANS OF SPEECH: By Georg Herman Von Meyer. 12mo., pp. 349. D. Appleton & Co., New York, 1883. For sale by M. H. Dickinson. $1.75.

This is the forty-sixth volume of Appleton's International Scientific Series, and is probably as practical and useful as any one of them. It is an attempt to to show that a true knowledge of the laws which govern the transformation of the elements of speech in the formation of dialects or derivative languages can only be obtained from a study of the physiological laws of the formation of articulate sounds. Hence the importance of the philologists becoming thoroughly acquainted with the structure and formation of the organs of speech.

The author is Professor of Anatomy at the University of Zurich, and the book is illustrated with some fifty wood engravings, prepared expressly for the purpose of demonstrating his views and theories. It is divided into three chapters, comprising respectively the formation of the organs of speech, the relation between the organs of speech and the formation of sound, and the formation of articulate sounds.

The object of the work being to discuss the structure and functions of the organs of speech, with special reference to the requirements of the philologist, it will be found that the descriptions of the anatomy and physiology of these organs all have this object plainly in view, and that there are various new and unusual interpretations of both presented.

So thorough a treatment of the subject is not found, so far as we know, in any other work, and musicians and public speakers, as well as philologists, will be especially interested in it from a business standpoint, if from no other.

WHERE DID LIFE BEGIN? By G. Hilton Scribner. 12mo., pp. 64. Chas. Scribner's Sons, New York, 1883. $1.25.

This is an inquiry as to the probable place of beginning and the natural causes of migration therefrom of the flora and fauna of the earth. The author's ordinary business duties are alleged by him to have been sufficient employment without engaging in scientific work, but having followed out certain lines of thought to their logical conclusions in his own judgment and submitted them to his friends, he was persuaded to publish them.

Assuming that the earth was at one time a fiery mass, the first question asked is "what part or parts of its surface first became sufficiently cooled by radiation to be habitable by plants and animals?" Inasmuch as the heat of the Sun upon the earth has always offsetted the heat radiated from the earth, to a certain extent, and this offsetting has been much less in degree at the poles than at the equator, necessarily the region about the poles cooled off and became habitable first. Besides this, the polar regions had less matter to cool, and radiated heat into space more rapidly in proportion to mass than any other portion of the earth's surface; consequently it seems evident that the polar regions necessarily passed through the different temperatures, climates and climatic conditions now characteristic of the various zones, before any other portion of the earth became habitable, and were actually adapted to all the requirements of animal and vegetable life before them. It is next assumed that life did actually commence within one or both of certain zones surrounding the poles and sufficiently removed from them to receive the least amount of sunlight necessary for animal and vegetable existence. Then the lowering temperature and its accompaniments crept slowly downward from the Arctic, through the temperate, to the torrid zone, and the differing forms of life kept pace, abandoning the polar region as its heat was reduced below the living point, and occupying the other zones by turns.

Having thus stated his premises and conclusions, the author proceeds to support them by the topographical condition of the earth's surface, the currents of the ocean, the movements of the winds, the fossil remains of animals and plants found in the polar regions, etc. His points are well made and carry connection with them. The work is logical throughout and attractively written.

ELECTRICITY IN THEORY AND PRACTICE: By Lieutenant Bradley A. Fiske, U. S. N. Octavo, pp. 270. Illustrated. D. VanNostrand, New York, 1883. $2.50.

To any student who desires a work lucidly explaining both the theory and practical applications of electricity, we can offer nothing better than this. As Lieut. Fiske says, many practical men and students have found great difficulty in seeing the relation between the theory of electricity and its practical applications "because they have had to study the theory from books devoted wholly to abstruse theory and the practical applications from books devoted wholly to the practical applications." His object has been to furnish a book showing the

principles upon which the practice depends, and explaining the theory of the practical applications. A glance through the table of contents will show how well this has been done, from the grouping and sequence of the topics alone, viz: Magnetism, Frictional Electricity, Work and Potential, Voltaic Batteries, Laws of Currents, Secondary or Storage Batteries, Thermo-Electric Batteries, Electro-Magnetism, Induction Currents, Electrical Measurements, Telegraphy, The Telephone, The Electric Light, Electric Machines, Electro-Motors, Electric Distribution of Power, Meters, Electric Railways.

A thorough examination shows much more than this; that the author not only understands his subject, but unlike many authors, appreciates the difficulties of those not so familiar with it and adapts his explanations and reasoning to their wants.

We find full and careful descriptions of the theory of telegraphy, including accounts of the various systems: of the telephone, with descriptions of its history, its uses and limitations, and the machinery used in receiving and transmitting messages: of the electric light and nearly all of the lamps invented, either arc or incandescence: the electric transmission of power by the series system, the multiple arc system, accumulator system, motor dynamo system, and induction system, with a careful statement of the advantages and disadvantages of each system: arrangement of accumulators, etc. The final chapter is devoted to Electrical Railways, with accounts of experiments therein in mines or street railway lines and elsewhere by Siemens, Field and others, including the accumulator system as tried in London, calculations of horse-power, economic considerations, etc.

In short, the work is just what it purports to be, "Electricity in Theory and practrice, or the Elements of Electrical Engineering," and cannot fail to be of especial service to persons who need, as most readers do, an explanation and clear understanding of the connecting links between theory and practice in this interesting and practical study. Inasmuch as we are emerging from the age of steam and entering upon that of electricity, such a book cannot be too widely distributed, either in the higher schools and colleges or among the mechanical portion of the people.

THIRD ANNUAL REPORT OF THE U. S. GEOLOGICAL SURVEY, 1881–2. J. W. Powell, Director. Octavo, pp. 564; Illustrated. Government Printing Office, Washington, D. C., 1883.

This handsome volume is made up of the report of the Director himself, the administrative reports of each of the assistants, Messrs. Clarence King, Arnold Hague, G. K. Gilbert, T. C. Chamberlin, S. F. Emmons, G. T. Becker, L. F. Ward, J. Howard Gore and Gilbert Thompson, and Accompanying Papers by Prof. O. C. Marsh, Roland D. Irving, Israel C. Russell, Arnold Hague, Thos. C. Chamberlin and C. A. White, M. D.

Major Powell reports the preparations made for a topographic map of the

Colorado Plateau region,—a district embracing portions of Utah, Colorado, New Mexico and Arizona—by Mr. Gilbert Thompson. In Colorado the field-work for a topographic map of the Ten-Mile Mining District has been finished, and the map completed, ready for the use of the geologist. In northern Nevada work has been commenced, which, in connection with previous surveys, will furnish a trusty map of northern and central Nevada.

Mr. Arnold Hague is preparing a memoir on the Geology of the Eureka District, Nevada, and the study of tl.e ore deposits of the same locality by Mr. J. S. Curtis has been finished so far as the field work is concerned. Mr. I. C. Russell, who has been studying the Quaternary lakes of the Great Basin, has completed his examination of Lake Lahontan, and has made a preliminary one of southeastern Oregon. Mr. S. F. Emmons has begun the investigation of the mining and general geology of the Ten-Mile District and of the vicinity of Golden, Colorado, and attention has been given to the soils in the neighborhood of Denver. Mr. Lester F. Ward spent the summer of 1881 in the collection of fossil plants in Colorado and Arizona. Dr. C. A. White began at the same time the collection of a parallel suite of invertebrate fossils, but being called off to investigate the problem of artesian water on the plains, was compelled to postpone it until another season. Prof. T. C. Chamberlin continued his work in examining and tracing the glacial moraines of Dakota and the associated features of the drift. Dr. Carl Barus, under the direction of Prof. Clarence King, has undertaken a series of experiments upon the chemical and physical properties of rocks and rock-forming materials under extreme conditions of temperature and pressure.

The accompanying papers above referred to make up the great bulk of the volume, and are as follows: Birds with Teeth, by Prof. O. C. Marsh; The Copper Bearing Rocks of Lake Superior, by Roland D. Irving; Sketch of the Geological History of the Eureka District, Nevada, by Arnold Hague; Preliminary Paper on the Terminal Moraine of the Second Glacial Epoch, by Thos. C. Chamberlin; A Review of the Non-Marine Fossil Mollusca of North America, by C. A. White, M. D.

There are thirty-five plates and fifty-six engravings, all admirably executed.

POLITICAL RECOLLECTIONS, 1840 TO 1872: Geo. W. Julian. 12mo., pp. 384. Jansen, McClurg & Co., Chicago, 1884. For sale by M. H. Dickinson. Price, $1.50.

Beginning with the "log cabin and hard cider campaign of Tippecanoe and Tyler too" in 1840, the author takes his reader through the exciting political history of the United States, down to 1872, the most important portion of the life of the Nation, since it includes the rise and progress of the slavery question, its settlement in the war of the rebellion and the reconstruction of the seceded States. During all this time, Mr. Julian was more or less actively engaged in politics and, for a number of years, in positions enabling him to command an

interior view of important measures and an intimate knowledge of the prominent men of his day. His account of the acts of the old Whig party, the evolution of the Republican party, the progress of Republicanism, the administration of Lincoln and the war, reconstruction and suffrage, impeachment, the Grant and Greeley campaign, and the numerous stirring incidents involved in all these wonderful changes in the affairs of the country, is necessarily interesting, doubly so from the familiar and impressive way in which it is handled. Aside from a somewhat undue airing of personal grievances, the whole account is decidedly attractive and valuable, especially in view of the many notices and anecdotes of the distinguished actors of the time, which doubtless are perfectly reliable.

To all readers whose recollection extends backwards over the period included, Mr. Julian's book will be a valued reminder of an exciting and important portion of their lives.

KNIGHT'S NEW MECHANICAL DICTIONARY. Section IV: Octavo, pp. 240. Illustrated. By Edward H. Knight, A. M., LL.D. Houghton, Mifflin & Co., Boston, 1883. $2.00.

Though Mr. Knight died just one year ago, before he had fully completed this the last volume of this valuable work, it was found after his death that he had left the remainder in such a forward state of preparation that the task of editing was confined chiefly to such arrangement of his material as would put it into the shape intended by him. The volume begins at "printing press" and ends with "zoögyroscope," and includes almost every imaginable machine between them. There are fifty-six full page plates, besides hundreds of smaller engravings and illustrations. Seemingly, no mechanical dictionary can be more complete than this, either in titles, references or descriptions. It is printed on most excellent paper and the engravings are admirable. The publishers certainly have done all in their power towards supplementing the labors of the accomplished and lamented editor.

BALLADS OF HOME: BALLADS OF BEAUTY: BALLADS OF BRAVERY: Edited by Geo. M. Baker. Lee & Shepard, Boston, 1883. For sale by M. H. Dickinson.

These three handsome volumes contain the choicest gems of poetry in the English language in the classes named, and their mechanism is fully worthy of their contents. Each volume comprises about one hundred and seventy-five pages, and is illustrated with forty full page illustrations. Among the authors, from whose works selections are given, we note Leigh Hunt, Tennyson, Browning, Read, Fitz James O'Brien, Rogers, Mrs. Hemans, Sheridan Knowles, Heine, Longfellow, Burns, Mary Howitt, Holmes, Spencer, Kingsley, Moore Saxe, Phoebe Cary, Bryant, Campbell, Aldrich, Willis, Wordsworth, Byron, Bulwer, and scores of other poets less known to fame.

OTHER PUBLICATIONS RECEIVED.

Reports of Observations and Experiments in Practical Work of Division of Entomology, by C. V. Riley, Government Printing Office, No. 3. Report of Entomologist, C. V. Riley, Ph.D., for 1883, Government Printing Office. Reports of Experiments, Chiefly with Kerosene on Insects affecting the Orange Tree and Cotton-Plant, C. V. Riley, 1883. Bulletin No. 1, Reports on Observations of Rocky Mountain Locust and Chinch-Bug, Government Printing Office, Bulletin No. 2, C. V. Riley. Proceedings of the Boston Society of Natural History, Vol. 22, Part 2, Boston, 1883, Edward Burgess, Sec'y. Winter Months in a Summer Clime: Through the Uplands to Florida, 1884. *Agricultural Review and Industrial Monthly.* $3.00 a year, published monthly; American News Company, General Agents. *International Review of Medical and Surgical Technics*, published quarterly, Boston, Mass., U. S. A., Vol. 1, No. 1. Alphabetical Lists of Patentees and Inventions for the half year January to June inclusive. Bulletin de La Société des Sciences Naturalles, De Neuchatel, Tome 13, 1883. Reports from United States Consuls, on the Commerce, Manufactures, etc., of their Districts, No. 34, October and November, 1883, Government Printing Office. Declared Exports of the United States, first and second quarters, 1883, Government Printing Office. *The Electrician and Electrical Engineer*, a monthly review, January, 1884, Vol. 3, No. 25; price 10c. *Journal of Progress*, Vol. 1, No. 3, 1884, $2 a year—10c. a number. Work and Wealth, by R. R. Bowker, N. Y., 25c. The *Indicator*, a magazine devoted to art and music; quarto, 20 pages, weekly, Chicago; $3.00 per annum.

SCIENTIFIC MISCELLANY.

THE OLD MAN OF HOY.[1]

REV. S. J. DOUGLASS.

Beside the Pentland Firth dwells the tallest man on earth,
With his head quite bare to the sky;
No roof can shelter him of towering castle grim,—
St. Peter's is a chapel in his eye.

This Old Man of Hoy was ne'er a little boy,
But always a giant grown;

1. * * * * Whether the sense, or nonsense of "The Old Man of Hoy" is worth a thought, is for you to say. If it is anything, it is a historico-geological sketch, suggested by Sir Walter Scott's and various travelers' descriptions of the rock, and especially by Mr. Geike's recent interesting paper upon it.—S. J. D.

Standing high above the shore, six hundred feet or more,
He is strong as though hewn out of stone.

Not a stripling of a day, but, his locks now iron-gray,
He has long felt the terrors of the North;
But his soul is sunny yet, and his face is ruddy yet,
And he knows what a blithe heart is worth.

How merrily he laughs, as the briny gale he quaffs,
And the sea-eagles scream 'round his ears!
The wildest storm may rave, he defies both wind and wave,
For he never feels a small man's fears.

O he, and he alone, knows who owned the Dwarfie Stone,
And hollowed its chamber strong:
A mighty troll and wife there spent a wondrous life,
His friends through a century long.

He, too, saw the Age of Ice, and he didn't think it nice;
He can tell us of Pict, Norse and Scot:
But for Odin's altar red, and his heroes' mounded bed,
And for Highland carls he cared not a jot:

With the Merry Men of Mey he would dance the livelong day,
Till he danced off a leg in the sea:
Still, the sturdy old chap scarcely ever took a nap,
And his one leg was equal to three.

With ancient Vikings tall, and more modern pirates small,
Full many a battle he has fought:
Yet across the boiling firth bubbled o'er his roaring mirth,
As he joked with Johnny O'Groat.

To the Old Man of Hoy what overflowing joy
Give still the rush and the roar of the waves— [beat,
Though the spray oft drives like sleet, and the winds like arrows
And the rain his gray beard laves!

Long life to the iron soul! While the Atlantic surges roll
May he manfully stand to the fight!
No nobler grave is found than old Ocean's depths profound,
Nor slab than the Carbuncle bright!

Like the Old Man of Hoy, let us heartily enjoy
What the time and the tide may send!
When low the breezes sigh, we will close the watchful eye,—
But with trouble we will battle to the end.

NEW HAVEN, CONN., January 17, 1884.

EDITORIAL NOTES.

THE Kansas City Academy of Science has received contributions to its museum from the following named gentlemen during the past month: From Gen'l John A. Halderman, Minister to Siam, 22 small rubies; from A. M. Stalnaker, of Springfield, Mo., two pieces of mastodon tusks; from Geo. R. Warren, of Kansas City, a copy of Thomas' Massachusetts Spy or Worcester Gazette, dated July 1, 1812; from J. W. Phillips, a large petrified root of a tree; from H. Holbrook, a very handsome specimen of zinc ore and a concretion simulating a vertebral bone.

DR. R. J. BROWN, President of the Kansas Academy of Science, gave us a very pleasant call last month. He is decidedly in earnest about the work of the Academy during his administration, and has appointed the following named committees, every member of which is believed by him to be a zealous worker in his special department of science: Geology—O. H. St. John, Bobert Hay, and Joseph Savage. Mineralogy—G. H. Failyer, Geo. S. Chase, and E. S. H. Bailey. Chemistry—E. S. H. Bailey, H. E. Sadler, and J. D. Willard. Physics—J. T. Lovewell, E. L. Nichols, and H. M. Aller.—Meteorology—F. H. Snow, J. T. Lovewell, and J. D. Parker. Astronomy and Mathematics—E. L. Nichols, D. E. Lautz, and J. A. Lippincott. Botany—W. A. Kellerman, J. H. Carruth, and E. N. Plank. Entomology—E. A. Popenoe, F. H. Snow, and F. W. Cragin, Ornithology—F. H. Snow, N. S. Goss, and L. L. Dyche. Ichthyology—I. D. Graham, F. W. Cragin, and D. B. Long. Herpetology—F. W. Cragin, F. H. Snow, and H. R. Morse. Anthropology—A. H. Thompson, Frank Kiser, J. R. Mead.

CAPT. H. H. C. DUNWOODY, of the U. S. Signal Office, at Washington, D. C., visited this city a few weeks since for the purpose of arranging for the establishing of a system of weather signals by which shippers and others can be warned of the approach of cold waves in time to prepare for them. If this system had been in operation on the first of January great loss of property and human suffering might have been prevented. Through Gen'l Nettleton and the Postmaster it has been arranged to have two signal flags displayed, one in West Kansas City and one up town, as soon as they they can be sent out. Capt. Dunwoody is also endeavoring to have the meteorologists of each State Weather Service coöperate with the Chief Signal Officer and thus secure a more effective general system than ever before.

MARSHALL L. WOLFE, Mining Inspector of Bates County, Mo., states in his Annual Report for 1883, that the number of acres of workable coal lands in the county has been increased by fresh discoveries and newly opened mines, from 95,000 to about double that number; that the number of mines operated in 1883 was about 250 and the amount of capital employed in coal mining $1,000,000.

BARON NORDENKSJOLD, the well known explorer of the Arctic regions, is contemplating another voyage. He intends, however, to leave the beaten track this time and go southward to the Antarctic circle. The attempt will be made in 1885.

THE Secretary of the Navy has instructed Commander Upshur at the New York Navy Yard to make suitable arrangements for the reception of the remains of DeLong and others of the ill-fated Jeannette on their arrival, which will be about the 15th inst. Chief Engineer Melville and Lieut. Danenhauer will take prominent parts in the ceremony. It is expected that these remains will finally be interred at the Annapolis Naval Cemetery.

AT a recent meeting the Directors of Washington University created a new chair of Dynamic Engineering. It will include, with what was formerly known as mechanical engineering, the application of electricity to the arts. The Secretary of the Navy has detailed Assistant-Engineer Wm. H. Alderdice to fill this chair.

GEN'L A. A. HUMPHREYS, late Chief Engineer of the United States Army, died suddenly on the 27th of December of heart-disease. He was not only distinguished in the line of his profession but was also a valued member of several of the most prominent scientific societies of this country and Europe.

PROF. ROMYN HITCHCOCK, the eminent microscopist of Washington City, pleasantly writes: "I am always pleased to get the Kansas City REVIEW, which I esteem very highly. There is always much good and instructive reading in it. I have not seen the January number yet, I hope you will at once send it."

MR. WM. F. E. GURLEY, of Danville, Ill., has published a preliminary notice of certain new fossils in the carboniferous deposits of West. If carried out on the plan proposed it will be a very valuable work. We notice among others, descriptions of new species named *Bellerophon Harrodi*, *Bellerophon textiliformis*, also *Discites Todannus*, all collected at Kansas City by Mr. David H. Todd, of this city. All western palæontologists should encourage Mr. Gurley in this work which will be continued from time to time and published in additional bulletins.

IN addition to Prof. Sternberg's palæontological labors in the West, of which he has so often given proof in the columns of the REVIEW, he has had his eyes open in a utilitarian direction also, the result being the discovery of a bed of very fine silica, which he is now using in the manufacture of a scouring soap for silver, steel, tinware, etc., at Lawrence, Kansas. Samples that we have seen and used give very satisfactory results.

MR. J. O. BROADHEAD, brother of Prof. G C. Broadhead, of Pleasant Hill, Mo., wrote him, upon reading his article in the November REVIEW, that General Cass told him at his residence, in Detroit, in 1864, "That he made the expedition from St. Louis to Detroit *the whole way in boats*, up the Illinois River and across from its head waters, through the lakes and swamps, to Lake Michigan."

THROUGH some oversight on the part of our reporter, credit was erroneously given to Prof. E. S. H. Bailey for the authorship of a paper upon "The Distribution of Saccharine Substance in the Stem of the *Sorghum Vulgare*," read before the Kansas Academy of Science. It should have been given to Prof. G. H. Failyer, of the Agricultural College at Manhattan, Kas., who has devoted much of his time to this subject and who has written a very complete report upon it for the last Quarterly Report of the State Board of Agriculture of that State.

WE acknowledge the receipt of a complimentary admission ticket from H. H. Warner, of Rochester, N. Y., to his observatory, which is in charge of Prof. Lewis Smith.

WE are promised for the next number of the REVIEW an article on archæology from the pen of Dr. Stephen Bowers, who has removed to San Buena Ventura, California, and is publishing the *Ventura Free Press*.

Also an article based on some pendulum experiments in Australia, China, and Japan, by Prof. H. S. Pritchett, of the Washington University, St. Louis.

Also an article on Crinoids by Prof. D. A. Bassett, formerly of Crawfordville, Indiana, now of Colton, California.

PROF. O. C. MARSH, President of the National Academy of Sciences has sent a report to the Commissioner of Internal Revenue, signed by several of the most eminent chemists of the country, to the effect that glucose as at present manufactured is of exceptional purity and uniformity of composition, containing no injurious substance and is in no way inferior to cane sugar in healthfulness.

to Prof. Gustavus Hinrichs, Director of the Iowa Weather Service, for a neat pamphlet comprising a report on the seasons in Iowa and a calendar for 1884. Prof. Hinrichs is a veteran meteorologist, and the Weather Service of Iowa is exceedingly complete.

WE also find in the Quarterly Report of the State Board of Agriculture of Kansas, a very comprehensive report upon the Meteorology of Kansas for 1883, by Prof. J. T. Lovewell, of Washburn College, Topeka, who is State Meteorologist at present. It is exceedingly full and satisfactory.

JOHN E. POTTER & CO., of Philadelphia, have just issued "The Elements of Botany," a new text-book, prepared by Prof. W. A. Kellerman, of the Kansas State Agricultural College. It is designed either for school use or for independent study, and is especially adapted to those students who are unable to give several years to this subject. An important feature, new to text-books of this science, is the department called "Economic Botany," in which the principles of Botany are applied to practical uses.

FROM the 13th Annual Report of the Kansas City Stock Yards by the Secretary, Mr. E. E. Richardson, we learn that the receipts of live stock for 1883 were as follows: Cattle, 460,780; Hogs, 1,379,401; Sheep, 119,665; Horses and Mules, 19,860. For the whole thirteen years they were: Cattle, 3,183,071; Hogs, 6,637,007; Sheep, 577,384; Horses and Mules, 108,474.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Atlantic Monthly* for February, 1884, presents the following table of contents: In War-Time, III., IV., S. Weir Mitchell. A Trio for Twelfth-Night, H. Bernard Carpenter. Voices of Power, O. B. Frothingham. A Roman Singer, XV., XVI., F. Marion Crawford. The Vagabonds and Criminals of India, Elizabeth Robins. Newport, XVIII.-XIX., George Parsons Lathrop. A Memory, A. A. Dayton. En Province, VI., Henry James. To-Day, Helen Gray Cone. In Madeira Place, C. H. White. A Visit to South Carolina in 1860, Edward G. Mason. Reminiscences of Christ's Hospital, J. M. Hillyar. Foreshadowings, Julia C. R. Dorr, The Confederate Cruisers. Mr. Trollope's Latest Character. Greater Britain and the United States. Mr. Crawford's To Leeward. The History of Sculpture. The Contributors' Club. Books of the Month.

THE *Adrian* (Mich.) *Times* is the first newspaper ever printed by power generated through the successful combustion of petroleum or any of its products. In the burner used the patentees seem to have solved the long sought for desideratum, the perfect and economical combustion of petroleum and its products, for the generation of heat.

PROF. EMIL SEIFERT, who is well known to our citizens as a musician of eminent attainments, has commenced the publication of a weekly quarto periodical entitled, "*The Western Art of America.*" The four numbers which have appeared give assurance of his talent and fitness for the work, and it is to be hoped that the citizens of this place and vicinity will give it a hearty and liberal support. $3.00 per annum.

THE Ft. Scott *Monitor* announces that a deposit of paraffine and crude oil has been discovered near Fontana, Kansas, at a depth of thirty-five feet below the surface.

THE fifty-second number of the *Humboldt Library of Science* comprises M. Th. Ribot's essay on "The Diseases of the Will," in which the various phenomena of impaired will power are carefully discussed and explained, with abundant illustrations from the history of many celebrated cases. Published by J. Fitzgerald & Co., New York; 15c.

THE *North American Review* for February contains an article by Mr. Carl Schurtz entitled "Corporations: Their Employees and the Public," in which he discusses the conflict between telegraph and railroad men and their employers; a sketch of the life and works of "Henry Vaughan, Silurist," a remarkable poet of the 17th century; the long expected article on "John Brown's Place in History," in answer to that recently published by Rev. David Utter; a very able and effective argument in favor of Greek and Latin in the Schools, by Prof. West of Princeton, etc. To builders the discussion of the "Rival Systems of Heating," by Professors Bell and Trowbridge will be found decidedly valuable and instructive.

THE *Magazine of American History* for January, 1884, appeared a week earlier than usual, and is replete with instruction and entertainment. This valuable periodical is without a rival in its special domain, and is rapidly becoming indispensable to all intelligent readers throughout the land.

THE Kansas City *Medical Record* is the title of a new journal just started in this city by Drs. Halley and Fulton. It is a very handsome monthly, filled with able original and selected articles pertaining to all branches of medicine. The reputation of its editors is a guarantee of its success, professionally and financially. $3 00 per annum.

PROF. C. A. YOUNG, of Princeton Observatory, in an article in the *Popular Science News*, upon the red glow at sunrise and sunset, says that it seems that the volcanic (dust) theory is more likely to be the true one than any that has been advanced. A chemist in New York claims to have collected from a bank of snow, remote from any settlement, enough of this dust to prove, by analyzing it, that it is composed of volcanic mineral. Mr. Whymper, the great mountain peak explorer, states in *Science* that he has seen this phenomenon distinctly produced by volcanic ashes and dust, in the air.

WE have received the January number of the second volume of the *Platonist*, edited by Thomas M. Johnson, of Osceola, in this State. It is to be an exponent of philosophic truth, and devoted mainly to the dissemination of Platonic philosophy, and as such should be patronized by all students of philosophy. 16 pages, large quarto, monthly, $2.00 per annum.

THE *Science Observer*, of Boston, states that a cable message was received at Harvard College Observatory, January 15, from Dr. Krueger, of Kiel, announcing the discovery of a comet at Melbourne, Australia, the position of which, on January 12, at Greenwich noon, was: R. A. 22h. 40m., Decl. —40° 8′. The comet is small, with a rapid motion towards the southeast.

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DR. STEPHEN BOWERS, - Editor and Publisher.

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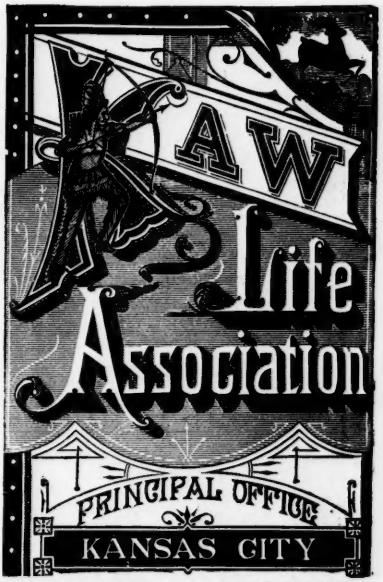

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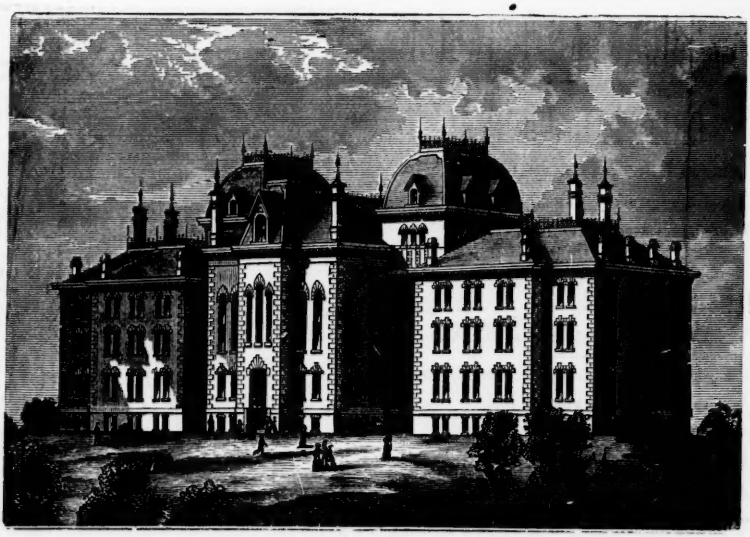

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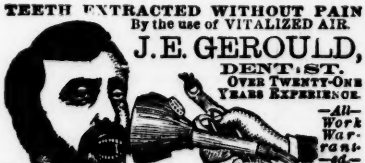

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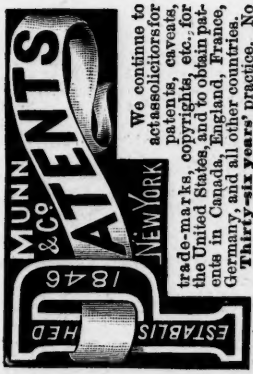

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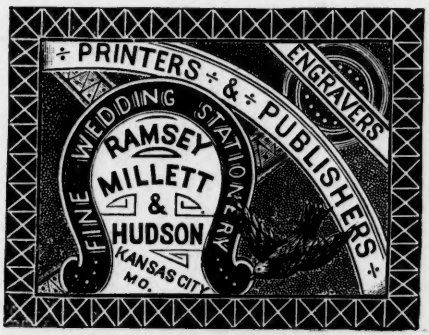

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